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WITH WHICH IS INCORPORATED

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BRIDGES--BUILDINGS--CONTRACTING--SIGNALING--TRACK

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Railroad Valuation.

In another part of this issue we publish the second paper on *Railroad Valuation*. This clearly shows the care and expense some railroads have gone to in order to get at the actual physical value of their properties. It also demonstrates the difficulty of getting at the true physical value. The cross sectioning of railway embankments has demonstrated that since the building of the roadway large amounts have been spent on widening of fills and additional ballast layers and the probabilities are that nearly all this has been charged to "maintenance account," instead of to "capital account." Whereas it is really a betterment and permanent improvement, which will not show in the "capitalization" of the railway company. This is the proper method to pursue in arriving at the true physical value of the permanent way. But it will cost the railway much more than the estimated $50,000,000.00 if this is pursued generally and will be another addenda to the so-called "Monumental Folly" of taking the valuation at all, for the purposes desired. The total capital of American railroads is approximately $20,000,000,000. An error of only 5 per cent in this valuation estimate means $1,000,000,000 for the total, so that guesswork becomes a question of vital moment. Basing rates upon so crude a foundation as the appraising judgment of reviewers would surely bring in its wake a trail of dire misfortune.

The Commission's Personnel.

We have constantly reiterated that both the personnel, and the number serving, of the Interstate Commerce Commission should be changed and added to, by the elimination of some of the attorneys and the addition of real railway experts. It is interesting to note that the renomination of one of the members has been held up by the United States Senate, in order to give the Senators an opportunity of looking into the Commission more thoroughly. It is to be hoped that this investigation may be held in a perfectly unbiased manner with no acumen whatever either political, against the Commission or the railways. If this is done we feel sure the Senate will become convinced of both necessity of change of the personnel of the Commission and the enlargement of the number on the Commission.

A Business Basis.

We publish an excerpt from one of the leading financial journals which states the importance of running the railways on a purely business basis is becoming most imperative. It calls attention to the fact that many of the railway executives have never had a general business training and experience. This is true as there are many railways that are financed and operated in a manner that is unbusinesslike to say the least, and which would not be tolerated for a moment in any other manufacturing plant. The railways are quasi public servants and consequently there are times when managements are compelled to operate and proceed along lines which they know are not good business policy—witness the carrying of the parcel post without sufficient remuneration—and which the other manufacturers would not undertake. An interesting thing in this connection is the fact that the financial heads themselves, whose thoughts are represented by the aforementioned journal, insist upon pursuing a policy that costs the railways thousands of dollars needlessly each year, that is, by having the fiscal year end on June 30th, instead of December 30th, as we mentioned editorially several months ago.

The Scale Experts.

The semi-annual convention of the National Association of Scale Experts takes place the first of February. There are great possibilities for this association to produce results that will be beneficial to the public, the manufacturers and the railways. A lot of needless discussion has taken place between the railways and the scale manufacturers. This has been caused by disagreements as to the amount of load and impact the scale receives under certain

conditions. The reason for the dissension is that neither one of them knows positively what this impact is, a satisfactory formula not having as yet been devised to cover all conditions. This is particularly so as regards the impact of the second pair of wheels of a car entering on the track rail of the weigh beam of the scale. Owing to the fact that the equipment, particularly the motive power, and wheel loads are so much heavier in this country than anywhere else, it is necessary for us to adopt a standard without leaning towards the precedents of other countries. This is what the Scale Experts are endeavoring to do, in addition to the United States Bureau of Standards, which has lately devoted a great deal of investigation and research to track scales, along scientific lines. After all a scale, of any denomination, is simply a unit of measure and the standards and specifications should be fixed by the Federal Government on the recommendations of the United States Bureau of Standards derived from their investigations in conjunction with the investigations and recommendations of the Scale Experts.

Gates.

The laws of the majority of the states are such that the railway must bear most of the responsibility of stock losses resulting from defective fencing. Most of this damage is chargeable to defective gates. With the increase in the cost and inferiority of lumber steel gates have come into use quite generally. In spite of the fact that a steel gate will last several times as long as a wooden gate, and that it is practically unbreakable, while at the same time, easier to open and close, it costs little or no more than the wooden gate. Wire fencing is manufactured in the field as are also the concrete posts which are replacing the wooden posts in right-of-way fencing in the best kept up properties.

One of the most prolific boosters of troublesome stock claims is carelessness with respect to proper closing of gates. This feature, of course, applies to all classes of gates, but to a far lesser extent where the gates are easily closed. The best steel gates are constructed with the idea of making them easy to close under difficult conditions, such as side-hill locations and snow blocked openings.

ACCIDENT IN THE NEW YORK SUBWAY.

On January 6th an accident occurred in the New York subway which was the cause of a great number of people being overcome by smoke and gas fumes. According to the reports of some of the daily papers the accident was caused by a collision between two trains. But this is not correct, as this subway is equipped with both the automatic block signal system and automatic train stops on the express tracks.

The trouble was caused by the feed cables short circuiting and burning out in two man-holes in 53rd street, one on the east side of Broadway and the other on the west side of Broadway. The smoke from the burning paper insulation of the cables and the acid from the melting copper and the lead covering of the cables affected passengers in the southbound trains which had been stopped at the signals about 150 feet north of the point where the short circuit occurred. A negative feeder broke down grounding to the sheath of a three-phase 11,000-volt cable which blew out, but not before sufficient arc had been formed to start some of the low tension cables going. There were, approximately, 24 of these in the man-holes at 53rd street. The gas generated blew off the door of the splicing chamber which opens directly into the subway. The shutting off of the power stalled the trains and the smoke caused a panic as well as overcoming a number of people with the fumes which contained a good deal of lead and copper as well as gases from burning insulation.

No cars took fire as none were opposite the splicing chamber. If the man-hole in the street leading to this chamber had not had such a strong and tight-fitting cover, it probably would have blown out and allowed the smoke to escape into the street instead of into the subway. The most obvious remedy for this trouble is to have strong doors to the splicing chambers and ventilate these chambers to the street instead of into the subway itself.

AMERICAN WOOD PRESERVERS' ASSOCIATION.

ELEVENTH ANNUAL CONVENTION.

The eleventh annual convention of the American Wood Preservers Association will be held at the Congress Hotel and Annex January 19, 20 and 21.

PROGRAM.

TUESDAY FORENOON, JANUARY 19.
10 o'clock.

Address of Welcome. Response. Roll Call.
Reading of Minutes, last Convention.
President's Address.....Geo. E. Rex
Secretary-Treasurer's Report.....F. J. Angier
Communications.
Report of Entertainment Committee....G. M. Davidson, Chairman

TUESDAY AFTERNOON, JANUARY 19.
2 o'clock.

PLANT OPERATION AND MISCELLANEOUS.

Report of Standing Committee No. 4 on Plant Operation....
.....H. M. Rollins, Chairman
Economical Use of Steam in Connection with Wood Preserving Plants.....A. M. Lockett
Temperature Changes in Wood Under Treatment....Geo. M. Hunt
(Illustrated.)
Report of Standing Committee No. 5 on Miscellaneous Subjects.....J. H. Waterman, Chairman

WEDNESDAY FORENOON, JANUARY 20.
10 o'clock.

PRESERVATIVES AND SPECIFICATIONS.

Report of Standing Committee No. 1 on Preservatives
.....Ernest Bateman, Chairman
Report of Standing Committee No. 2 on Specifications for the Purchase and Preservation of Treatable Timber.....
.....E. A. Sterling, Chairman
A Specification for a Coal Tar Creosote Solution.....
.....Hermann von Schrenk and Alfred L. Kammerer
The Comparative Toxicity of Coal Tar Creosote and Creosote Distillates and of Individual Constituents for the Marine Wood Borer, Xylotrya.....L. F. Shackell, M. D.

WEDNESDAY AFTERNOON, JANUARY 20.
2 o'clock.

TIES, TIMBER, PILING AND CROSS ARMS.

A Method for Finding the Annual Charges for Ties.....
.....Harrington Emerson and T. T. Bower
The Mechanical Life of Ties as Affected by Ballast....E. Stimson
(Illustrated.)
Additional Facts on Treated Ties.....J. H. Waterman
Air Seasoning of Cross Ties.....A. H. Noyes
Sill Ties.....F. J. Angier
Final Inspection of Ties and Timber.....C. M. Taylor
A Voice from the Pacific Coast.....H. E. Horrocks
Treated Timber for Factory Construction.....F. J. Hoxie
(Illustrated by Stereopticon Views.)
Destruction of Timber by Marine Borers.....E. S. Christian

THURSDAY FORENOON, JANUARY 21.
10 o'clock.

WOOOD BLOCK PAVING.

Report of Standing Committee No. 3 on Wood Block Paving
.....Clyde H. Teesdale, Chairman
The Bleeding and Swelling of Paving Blocks...Clyde H. Teesdale
Laboratory Analysis After Treatment vs. Actual Record During Treatment of Creosoted Wood Paving Blocks.....
.....Frank W. Cherrington

THURSDAY AFTERNOON, JANUARY 21.
2 o'clock.

BUSINESS SESSION.

Report of Committee No. 6 on Constitution and By-Laws....
.....A. E. Larkin, Chairman
Report of Committee on Resolutions. New Business.
Election of Officers. Selection of Next Meeting Place.
Adjournment.

FRIDAY, JANUARY 22.
Trip to Forest Products Laboratory, Madison, Wis.

COMMITTEE APPOINTMENTS, BRIDGE AND BUILDING ASSOCIATION.

The American Railway Bridge and Building Association have announced the following appointments on committees for the ensuing year:

SUBJECTS AND COMMITTEE APPOINTMENTS FOR 1915.

1. Use of Locomotive Cranes.
   G. W. Rear, Chairman, Sou. Pac. Co., San Francisco, Cal.
   A. T. Mercier, Sou. Pac. Co., Los Angeles, Cal.
   D. E. Plank, Pac. Elec. Co., Los Angeles, Cal.
   D. A. Shope, A. T. & S. F. Ry., Fresno, Cal.
   W. O. Eggleston, Erie R. R., Huntington, Ind.
   E. T. Howson, Railway Age Gazette, Chicago, Ill.
   G. H. Stewart, B. R. & P. Ry., East Salamanca, N. Y.
   E. B. Ashby, L. V. R. R., New York City.
2. Pile and Timber Trestle Bridges.
   A. B. McVay, Chairman, L. & N. Ry., Evansville, Ind.
   C. E. Smith, Mo. Pac. Ry., St. Louis, Mo.
   F. G. Jonah, St. L. & S. F. Ry., St. Louis, Mo.
   S. T. Corey, C. R. I. & P. Ry., Chicago, Ill.
   J. J. Taylor, K. C. S. Ry., Texarkana, Tex.
   E. J. Auge, C. M. & St. P. Ry., Wells, Minn.
   A. J. James, A. T. & S. F. Ry., Topeka, Kan.
   S. C. Tanner, B. & O. R. R., Baltimore, Md.
3. Railway Water Tanks.
   C. R. Knowles, Chairman, I. C. R. R., Chicago, Ill.
   A. A. Wolf, C. M. & St. P. Ry., Milwaukee, Wis.
   O. M. Suter, I. C. R. R., Chicago, Ill.
   T. J. Stuart, W. Pac. Ry., Elko, Nev.
   Jas. Dupree, C. T. H. & S. E. Ry., Crete, Ill.
   A. C. Sydell, C. B. & Q. R. R., Chicago, Ill.
   F. M. Case, C. & N. W. Ry., Belle Plaine, Iowa.
4. Small Coaling Stations.
   Lee Jutton, Chairman, C. & N. W. Ry., Madison, Wis.
   W. T. Krausch, C. B. & Q. R. R., Chicago, Ill.
   G. Aldrich, N. Y., N. H. & H. R. R., Boston, Mass.
   B. F. Pickering, B. & M. R. R., Salem, Mass.
   A. W. Pauba, C. & S. Ry., Denver, Colo.
   J. L. Talbott, A. T. & S. F. Ry. Pueblo, Colo.
   G. A. Manthey, Soo Line, Minneapolis, Minn.
   Wm. Mahan, W. & L. E. Ry., Canton, Ohio.
5. Costs of Structures.
   G. A. Rodman, Chairman, N. Y., N. H. & H. R. R., New Haven, Conn.
   F. E. Weise, C. M. & St. P. Ry., Chicago, Ill.
   J. H. Neuelle, N. Y. O. & W. Ry., Middletown, N. Y.
   J. S. Robinson, C. & N. W. Ry., Chicago, Ill.
   R. C. Sattley, C. R. I. & P. Ry., Chicago, Ill.
   C. W. Wright, Long Island R. R., Jamaica, N. Y.
   W. A. Pettis, N. Y. C. Lines, Rochester, N. Y.
6. Efficient Methods of Handling Work and Men.
   G. W. Rear, Chairman, Sou. Pac. Co., San Francisco, Cal.
   J. F. Pinson, C. M. & St. P. Ry., Seattle, Wash.
   E. R. Wenner, Lehigh Valley R. R., Ashley, Pa.
   C. R. Knowles, I. C. R. R., Chicago, Ill.
   R. H. Reid, L. S. & M. S. Ry., Cleveland, Ohio.
   H. A. Horning, M. C. R. R., Jackson, Mich.
   S. C. Tanner, B. & O. R. R., Baltimore, Md.
7. Warnings for Overhead and Side Obstructions.
   E. G. Storck, Chairman, P. & R. Ry., Philadelphia, Pa.
   M. M. Barton, P. R. R., West Philadelphia, Pa.
   F. E. Schall, Lehigh Valley R. R., South Bethlehem, Pa.
   T. E. Thomas, B. & O. R. R., Wilmington, Del.
   E. S. Meloy, C. M. & St. P. Ry., Chicago, Ill.
8. Reinforced Concrete Bridge Work.
   O. F. Dalstrom, Chairman, C. & N. W. Ry., Chicago, Ill.
   I. L. Simmons, C. R. I. & P. Ry., Chicago, Ill.
   J. A. Bohland, G. N. Ry., St. Paul, Minn.
   C. J. Scribner, C. B. & Q. R. R., Chicago, Ill.
   D. C. Zook, Pennsylvania Lines West, Ft. Wayne, Ind.
   T. J. Stuart, W. P. Ry, Elko, Nev.
9. Station Buildings for Passenger Service Only.
   M. A. Long, Chairman, B. & O. R. R., Baltimore, Md.
   E. B. Ashby, Lehigh Valley R. R., New York City.
   G. W. Andrews, B. & O. R. R., Baltimore, Md.
   K. Peabody, New York Central Lines, Rochester, N. Y.
   R. McKibben, P. R. R., Altoona, Pa.
   W. T. Krausch, C. B. & Q. R. R., Chicago, Ill.
10. Concrete Culvert Pipe and Concrete Piles.
    H. Rettinghouse, Chairman, C. St. P. M. & O. Ry., St. Paul, Minn.
    S. T. Corey, C. R. I. & P. Ry., Chicago, Ill.
    G. H. Stewart, B. R. & P. Ry., East Salamanca, N. Y.
    C. F. Urbutt, C. M. & St. P. Ry., Chicago, Ill.
11. Crossing Gates, Towers, etc.
    S. C. Tanner, Chairman, B. & O. R. R., Baltimore, Md.
    E. C. Morrison, Sou. Pac. Co., San Francisco, Cal.
    J. H. Johnston, G. T. R., Montreal, Que.

NOMINATIONS.

R. H. Reid, L. S. & M. S. Ry., Cleveland, Ohio.
S. F. Patterson, Concord, N. H.
J. N. Penwell, L. E. & W. R. R., Tipton, Ind.
J. P. Canty, B. & M. R. R., Fitchburg, Mass.
F. E. Schall, L. V. R. R., South Bethlehem, Pa.

SUBJECTS.

F. E. Weise, C. M. & St. P. Ry., Chicago, Ill.
C. E. Smith, Mo. Pac. Ry., St. Louis, Mo.
E. C. Morrison, Sou. Pac. Co., San Francisco, Cal.
G. Aldrich, N. Y., N. H. & H. R. R., Boston, Mass.

RELIEF.

A. Montzheimer, E. J. & E. Ry., Joliet, Ill.

MEMBERSHIP.

H. A. Horning, M. C. R. R., Jackson, Mich.
J. A. Bohland, G. N. Ry., St. Paul, Minn.
G. A. Rodman, N. Y., N. H. & H. R. R., New Haven, Conn.
I. O. Walker, N. C. & St. L. Ry., Paducah, Ky.

PUBLICATIONS.

J. S. Robinson, C. & N. W. Ry, Chicago, Ill.
E. S. Meloy, C. M. & St. P. Ry., Chicago, Ill.
R. C. Sattley, C. R. I. & P., Chicago, Ill.

ARRANGEMENTS.

J. P. Wood, P. M. R. R., Saginaw, Mich.
P. J. O'Neill, L. S. & M. S. Ry., Adrian, Mich.
S. D. Bailey, M. C. R. R., Detroit, Mich.
F. P. Sisson, G. T. R., Detroit, Mich.

OBITUARY.

B. F. Pickering, B. & M. R. R., Salem, Mass.

ROADMASTERS' ASSOCIATION COMMITTEE ASSIGNMENTS.

The personnel of the committees assigned to this work are:

New and Experimental Track Accessories and Tools: William Shea (C. M. & St. P.), chairman, J. W. Dahl (N. Y. C. & H. R.), J. O'Connor (M. St. P. & S. S. M.), D. O'Hern (E. J. & E.), Emmet Keough (C. B. & Q.), and George Beckingham (G. T.).

Proper Organization of Section Forces and Methods for Maintaining and Policing Track:—

Sub-committee No. 1, For High Speed, Heavy Traffic Railroads: M. E. Eagan (N. Y. C. & H. R.), chairman, H. Ferguson (G. T.), A. L. Kleine (A. T. & S. F.), W. P. Murn (N. P.), J. E. McNeil (A. T. & S. F.), David Mau (C. M. & St. P.) and L. C. Ryan (C. & N. W.).

Sub-committee No 2, For Light Constructed Railroads Carrying Heavy Traffic: J. Buel (A. C.), chairman, J. W. Fletcher, Jr. (Car. & N. W.), William Wharry (G. T.), H. A. Buel (C. M. & St. P.), George Corcoran (C. & N. W.), E. W. Gulley (C. R. I. & P), and B. F. Harrison (C. R. I. & P.).

Sub-committee No. 3, For Large Terminals: G. H. Brooks (St. L. T.), chairman, David McCooe (G. T.), F. E. Crabbs (C. & N. W.), William Lawrenz (C. & E. I.), A. M. Anderson (C. M. & St. P.), J. P. Corcoran (C. & A.), M. Griffin (C. R. R. of N. J.), and T. F. Donahoe (B. & O.).

SEMI-ANNUAL MEETING NATIONAL ASSOCIATION OF SCALE EXPERTS.

The eleventh semi-annual meeting of the National Association of Scale Experts will be held at the Fort Dearborn Hotel, Chicago, February 1, 2 and 3, and the following program has been arranged:

MONDAY, FEBRUARY 1.

MORNING SESSION 9:30 A. M.

1. Address of Welcome.....Hon. Carter H. Harrison, Mayor, City of Chicago.
2. Response.....Mr. C. C. Neale, Commissioner, Weights and Measures, State of Minnesota.
3. Registration of Members and Receiving of Applications.

AFTERNOON SESSION 2:00 P. M.

4. Installation, Maintenance and Care of Track Scales, Mr. A. Malmstrom, Chief Scale Inspector, Santa Fe System.
5. Automatic Scales and their Mechanical Construction, Mr. F. E. Kaeppel, Sales Agent, Fairbanks-Morse Co., Chicago.
6. Test of Railroad Track Scales.....Mr. D. J. McGrath, Scale Expert of State of Minnesota.
7. Discussion.

TUESDAY, FEBRUARY 2.

MORNING SESSION.

8. Delegates will meet at the Fort Dearborn Hotel, 9:30 a. m., and be conducted to Fairbanks' shop, where practices will be demonstrated by experts in the fitting and sealing of levers.
9. Association Dinner—Fort Dearborn Hotel—1:00 p. m.
10. Subject not yet determined.....Mr. A. W. Epright, Scale Inspector, Pa. R. R., Altoona, Pa.
11. Address by.....Dr. S. W. Stratton, Director, Bureau of Standards.
12. Board of Trade Weighing.....Mr. J. A. Schmitz, Editor, Scale Journal.

WEDNESDAY, FEBRUARY 3.

MORNING SESSION, 9:30 A. M.

13. Weighing and Recording of Weights.....Mr. L. M. Allen, Dist. Supt., Western Weighing & Inspection Bureau, Omaha, Neb.
14. Recording Weights—Calling every weight by its right name.....Mr. F. C. Maegly, Asst. Gen. Freight Agent, Santa Fe System, Chicago, Ill.
15. Mr. Charles F. Bruning will make an address on the subject of Scales from the viewpoint of a "Salesman."

AFTERNOON SESSION. 2:00 P. M.

Answers to Questions.
Election of Officers.
Unfinished Business.
New Business.
Adjournment.

The association cordially extends to you an invitation to be present, or represented by one or more of your scale experts, or by anyone interested in the weighing proposition in your business. J. M. Heinen, Secretary, 228 Inglehart Avenue, St. Paul, Minn.

$13,000,000 APPROPRIATED BY C., M. & ST. P. TO ELECTRIFY.

The Chicago, Milwaukee & St. Paul railroad has just made an appropriation of $13,000,000 for disbursement on electrification of its lines in the Rocky mountain district within four years.

Contracts for work have been let and operations have been commenced for the electrification of the Puget Sound lines, between Avery, Idaho, and Harlowton, Mont., a distance of 440 miles, with ten miles of sidings additional.

It is proposed to haul freight trains of 2,500 tons at a speed of from fifteen to eighteen miles an hour over the mountain divisions, while passenger trains are expected to make twenty-five miles an hour. Contracts have been made for the electrical power.

A BUSINESS BASIS ESSENTIAL.

The importance of the railroad dollar, of making every dollar yield full value and of saving every dollar—of, in fact, running the roads on a business basis—is now perhaps, for the first time in the career of railroads, becoming most impressive. What provision is there in the great industry for any such unremitting supervision of expenditures to see that every dollar counts, such as prevails in all successful business?

If we look through the lists of names and the record of the lives of the presidents or operating heads of railroads of the present day, we find men of ability and executive distinction in their respective lines, but how many of them, or rather how few, if any, have ever had a business training and experience, and such training, experience and demonstrated proficiency is absolutely necessary in making a railroad or anything else a business success. We find in nearly every instance that the president or operating head has been promoted from the ranks of railroad operation and, however important proficiency here may be, it does not take the place of thorough business education. In former days of development and extension, operating genius and ability was, perhaps, the most important qualification of railroad managers, but today the business success of a road is essential to its very life and existence outside of the bankruptcy courts. Successful business executives are harder to get than good operating men, but in the new order of things this department will have to receive the greatest attention. We have had some notable examples of men financially interested themselves in their properties and through their great business ability working out wonderful railroad successes. Of this type were Harriman and Hill, and Union Pacific, Southern Pacific, Great Northern and Northern Pacific are the results.—*The Bache Review.*

RESEARCH FELLOWSHIPS IN THE ENGINEERING EXPERIMENT STATION.

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN, ILL.

The director of the Engineer Experiment Station has issued the following circular in regard to Research Fellowships:

"To extend and strengthen the field of its graduate work in engineering, the University of Illinois has since 1907 maintained ten Research Fellowships in the Engineering Experiment Station. These fellowships, for each of which there is an annual stipend of $500.00, are open to graduates of approved American and foreign universities and technical schools. Appointments to these fellowships are made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met the Master's degree will be granted. Not more than half of the time of the Research Fellows is required in connection with the work of the department to which they are assigned, the remainder of the time being available for graduate study.

Nominations to fellowships, accompanied by assignments to special departments of the Engineering Experiment Station, are made from applicatons received by the director of the station each year not later than the first day of February. These nominations are made within the month of February by the station staff, subject to the approval of the faculty of the graduate school and the president of the university. Appointments are made in March, and they take effect the first day of the following September. Vacancies may be filled by similar nominations and appointments at other times.

Nominations to these fellowships are based upon the character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Preference is given those applicants who have had some practical engineering experience following their undergraduate work.

The Engineering Experiment Station, an organization within the College of Engineering, was established in 1903 for the purpose of carrying on investigations in the various branches of engineering, and for the study of problems of importance to engineers.

Railroad Valuation—Valuation Forms.

H. H. Edgerton, assistant engineer, C. G. W. R. R.

SECOND PAPER.

The various railroad commissions, some other bodies of men, and some individuals, have attempted to get out sets of forms for valuation. Nearly all of these are incomplete in items, and 90 per cent of them are poorly arranged as to subheads and column spacing. One of the most prominent bodies of men simply got out a cumbersome list of items, left it to the printer to arrange the column spacing, and something came out in the wash similar to a laundry bill.

But the valuation engineers at the department head of large railroads have each worked out sets of forms suitable to the railway lines under their charge. Of these the most conspicuous for completeness and column arrangement are the forms devised by Mr. E. Holbrook, special engineer for the Union Pacific. They are in bound volumes. The sheets are 17 by 25½ inches, with the right of way sheet double that size and the shop machinery sheets 8½ by 14. In these forms of Mr. Holbrook's even the title on the outside speaks distinctly when it says:

FORMS
USED IN ARRIVING AT THE
INVESTED COST AND COST TO REPRODUCE
THE PHYSICAL PROPERTY OF THE
UNION PACIFIC SYSTEM
IN THE UNITED STATES
AS OF JUNE, 1910.

And from that on follows 63 forms, one to each page, in which everything is clearly set forth to obtain the value of the transportation plant.

denied; it is obvious at once that such quantities really exist, and anyone attempting to change the figures would have to consider each item before being justified in doing so.'' We have in this issue reproduced the heading and arrangement of a few of the sheets.

As in all good sets of forms each page should have a title, as for instance:

ENGINEERING
I. C. C. Construction Account No. 1
Form No. 20,000

And at the left hand upper corner of the sheet:

Operating Company.....Division .....
Corporation .....Main or branch line.....
State or Territory.....

and at the right hand upper corner of the sheet:

Date compiled .....
Compiled by .....

† From existing records
* From records of analogous cases
o From measurements on the ground

The titles of these 63 form sheets of Mr. Holbrook's are:

Engineering.
Right of Way and station grounds.
Railway terminal grounds.
Special sheet cost values of railroad real estate (double sheet).

Name of Owning Co.....
Name of Operating Co.....
R.R.Line.....
State.....County.....
Vol. Section.....Taxing Dist.....
Name of City or Town.....

ABBREVIATIONS
Sec. No. = Section House
R/W = Right of Way
Sta. Gd. = Station Grounds
W.D. = Warranty Deed
Q.C.D. = Quit Claim Deed
Condⁿ = Condemnation
Ad. Poss. = Adverse Possession

SCHEDULE OF LANDS, RIGHT OF WAY AND TERMINALS AND THEIR TOTAL COST

SHEET NO .....
Compiled by .....
Checked by .....
Map No. .....
Other References .....

Serial No. on Map	Name of Grantor	Name of Grantee	Title or kind of instrument (deed, tax or other title acquired by purchase, condemnation, lease, agreement, franchise or otherwise)	Date of Acquisition	County Record: Book	Folio	Date	Reference to Land & Tax Owners Files	Description of Tract: Location	Sec.	Twp.	Range	Width Feet	Length Feet	Area in: Sq. Ft.	Acres	Use made of Lands	Consideration in Deed	Value of Equal Area of Adjacent Lands	Usual Cost to R.R. Co. of Equal Area	Expenses of Acquisition (attorneys, engineering, surveys, etc.)	Other Expenses (Sections enclosed thus: [ ] are to be entered in red)	Total Cost	Remarks
	TOTAL																							

Note: Property owned or operated by different companies should be shown on separate sheets. Similar separation should be made between City and Rural property. Where the "Consideration Paid" is anything other than money, state description of the item entering into the transaction here, and the money of each estimated and indicated as such.

Holbrook Valuation Form. Lands, Right of Way and Terminals. Union Pacific.

''To intelligently present in detail the information assembled, forms were prepared to show segregation by

(1) Corporations,
(2) States and Territories,
(3) Main or Branch Lines,

as well as to arrange to comply with the Interstate Commerce Commission's classification of 'Expenditures for Road and Equipment;' this necessitating, in some instances, several forms for assembling one account. To reduce the great number of supporting papers the largest form thought to be most convenient in handling, viz., 17"x25½", was chosen, and three years of experience indicates the wisdom of this choice. Small forms require the continual reference to supporting papers, which are extremely voluminous, even with forms such as we have designed.''

''The objection to our forms, viz., inconvenience in handling and filing because of their size, is obvious to anyone whether they are at all familiar with valuation work or not. *Their advantage is only apparent to those familiar with such work. The most important point in their favor is the psychological effect of showing, for all quantities, the details which made them up, and, further, that these details are the most effective defense possible of the values given. Where each separate detail entering into any one account shows upon the form, it cannot be lightly passed over or*

Recapitulation of land data.
Statement of railroad transfers used in determining railroad rate.
Real estate I. C. C. account No. 3.
Grading I. C. C. account No. 4.
Tunnels.
Combination and Howe truss bridges.
Details for false work combination and Howe truss bridges.
Open culverts, frame, steel stringer and ballast deck bridges.
Steel bridges and viaducts.
Details for false work for steel bridges.
Pipe box and timber culverts.
Rail top, masonry, arch and box culverts.
Ties.
Rails.
Frogs and switches.
Railroad grade crossings.
Track fastenings.
Ballast.
Track laying and surfacing.
Roadway tools.
Fencing right of way.
Crossings and signs.
Interlocking and other signal apparatus.

OFFICE FURNITURE AND FIXTURES
IN CERTAIN
GENERAL OFFICES AND OUTSIDE AGENCIES
ON AND OFF THE LINE OF ROAD

20,025½

DISTRIBUTION
* Total Original Cost
# Total Cost to Reproduce

APPORTIONMENT TO CORPORATIONS.—PER STATEMENTS ISSUED BY DEPUTY CONTROLLER, UNION PACIFIC SYSTEM—SOUTHERN PACIFIC COMPANY, NOV 25th AND 29th, 1911, AND PER TELEGRAMS FROM AUDITOR, SOUTHERN PACIFIC COMPANY SEPT 11th AND 12th, 1912, ADDRESSED TO E. HOLBROOK, SPECIAL ENGINEER, AND TO STATES.—EITHER ON ROAD MILEAGE WITHIN EACH STATE FOR EACH CORPORATION, OR STATE IN WHICH AGENCY IS LOCATED

CORPORATION	IOWA	NEBRASKA	WYOMING	UTAH	MISSOURI	KANSAS	COLORADO	IDAHO	MONTANA	WASHINGTON	NEVADA	CALIFORNIA	OREGON	ARIZONA	NEW MEXICO	TEXAS	LOUISIANA	MEXICO		ATLANTIC SS LINES (FIGURES NOT TO BE USED)	TOTAL ORIGINAL COST	# TOTAL COST TO REPRODUCE	
																		LOWER CALIFORNIA	SONORA				
Union Pacific Railroad *																							
#																							
Oregon Short Line Railroad *																							
#																							
Oregon Railroad & Nav. Co - Rail Lines *																				*			
#																							
Oregon & California Railroad *																					*		
#																							
South Pacific Coast Railway *																							
#																							
Central Pacific Railway *																							
#																					*		
Southern Pacific Railroad *																							
#																							
Louisiana Western Railroad *																							
#																							
Nevada & California Railway *																							
#																							
New Mexico & Arizona Railroad *																							
#																							
California Northeastern Railway *																							
#																							
Coos Bay, Roseburg & E.R.R. & Nav Co *																							
#																							
Corvallis & Eastern Railroad																							
#																							
Arizona Eastern Railroad *																							
#																							
Phoenix & Eastern Railroad *																							
#																							
Galveston, Harrisburg & S A Ry *																							
#																							
Texas & New Orleans Railroad *																							
#																							
M L & T R R & S.S Company *																							
#																							
Iberia & Vermillion Railroad *																							
#																							
Lake Charles & Northern Railroad *																							
#																							
Houston & Texas Central Railroad *																							
#																							
Houston East & West Texas Railroad *																							
#																							
Houston & Shreveport Railroad *																							
#																							
Atlantic Steamship Lines *																							
#																							

Compiled by E. Holbrook, Special Engineer from Information Furnished by and Through Offices of Messrs W. A. Worthington, J. C. Stubbs, L. J. Spence, E. O. McCormick, Gerrit Fort, H. S. Bradt, and C. B. Seger, officers of the lines interested

Holbrook Valuation Form. Office Furniture and Fixtures. Union Pacific.

Holbrook Valuation Form. Land Data. Union Pacific.

RECAPITULATION OF LAND DATA AND Recapitulation of Resulting "Reproduction Cost" Values of Right of Way, Station Grounds, Terminal Grounds and Real Estate As of June 30th, 1910

Corporation
State.

20.0021

Date Compiled
By.

THROUGH RURAL LANDS — MILES OF RAILROAD — PRIVATE TRANSFERS WITHIN — SELLING PRICE — MILES OF RAILROAD — 1910 ASSESSED VALUES OF IMMEDIATELY ADJACENT PRIVATE LAND — RESULTING FIGURES

THROUGH CITIES AND TOWNS — PRIVATE TRANSFERS WITHIN CORPORATE LIMITS — 1910 ASSESSED VALUES OF IMMEDIATELY ADJACENT PRIVATE LANDS OR PIECES OF LAND — RESULTING FIGURES

County or Parish	Liber Folio	No. of Deeds	Total Selling Price	Selling Price per Acre	Total	Assessed Value per Mile	Ratio %	Assessed Value per Mile	Ratio %	Assessed Value per Mile	Total Value	Population	Liber Folio	No. of Deeds	Total Selling Price	Total Area	Ratio A / C	Assessed Value per Mile	Ratio %	Assessed Value per Mile	Assessed Value per Acre	Ratio %	Assessed Value per Acre	Total Value
1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X

EXPLANATORY REMARKS

INSTRUCTIONS

One line of this form to be used for the data for a single county or parish, in the case of rural right of way and a single town or city in the case of city or town property.

Values should be given to the nearest dollar—cents should not appear.

Ratios should show to two decimal points.

Compile under sub-head of main line division and branches so that the total may be shown separately for each.

Note the manner in which the method employed was used and where figures of value were applied based on personal opinions, the source of information, manner of handling, and extra supporting data. Where more than one ratio has been used on a county or parish use a line for each different ratio, or one line showing the average ratio.

Authority for the application of the Railroad Ratios shown in columns 14, in the case of Rural Lands, and in column 21, in the case of Cities and Towns are to be shown in the detail prescribed, on the accompanying Form No. 20.0022

Telegraph and telephone lines.
Station buildings and fixtures.
General office buildings and fixtures.
Office furniture and fixtures.
Distribution to states and corporations office furniture.
Shops, engine houses, and turntables.
Transfer tables.
Shop machinery and tools.
Invested cost and cost of reproduction shop machinery and tools.
Shop machinery and tools (small sheets).
Shop machinery and tools (headings for 36 small sheets).
Shop machinery and tools,—summary.
Water stations.
Fuel stations.
Grain elevators.
Storage warehouses.
Docks and wharves.
Electric light plants.
Electric power plants.
Electric power transmission.
Gas producing plants.
Miscellaneous structures.
Solidification and seasoning.
Values and cost of reproduction, steam locomotives.
Passenger train cars values and cost of reproduction.
Freight trains cars " " "
Work equipment " " "
Floating equipment.
Transportation of men and materials.
Rent of equipment and repair of equipment.
Injuries to persons.
Law expenses.
Stationery, printing, insurance, and taxes.
Interest and commissions.
Rents, paid and received.
Material and supplies on hand.
Other expenses.
Recapitulation.

Many of the above subjects have received official designation by numbers at the hands of the Interstate Commerce Commission, while for some others they have not acquired the information and seem to be in ignorance that they exist.

The last sheet, recapitulation, is very interesting. In it all the other items are set down on the left hand column, and then to the right the space is divided into columns for different periods of development, preliminary period first and second year, construction period, third, fourth, fifth, sixth and seventh year; operating period eighth year, total cost of reproduction, cost per road mile.

Under the head of Engineering Mr. Holbrook has placed in subheads and columns as follows:

Location, station or mile.....:
From....., To....., Miles....., County....., State.....,
Reconnoissance and Exploration
Rate ....., Amount.....,
Instrumental surveys preparatory to construction
Rate ....., Amount .....,
Engineering and supervision of construction:
Items
2—35½ and 37—46 inclusive, Rate ....., Amount .....,
Totals and Remarks.....

OFFICE FURNITURE AND FIXTURES IN CERTAIN GENERAL OFFICES AND OUTSIDE AGENCIES ON AND OFF THE LINE OF THE ROAD

ARTICLES

Desks of all kinds.
Tables of all kinds, including drafting tables.
Chairs of all kinds.
Book cases, section or other.

20,051

Operating Company _____ Division _____

Corporation _____ Main or Branch Line _____

State or Territory _____

Material and Supplies on Hand

20,051

Date Compiled _____

†FROM EXISTING RECORDS
*FROM RECORDS OF ANALOGOUS CASES

	CLASSIFICATION	Unit	Quantity	Weight	Initial Cost	P & S Expense	Freight	Total Value	REMARKS
	1 Air Brake Material								
	2 Axles—Car	lbs.							
	3 Axles—Locomotive	lbs.							
	4 Bearings—Journal(Car and Tender)	lbs.							
	5 Bolts, Rivets, Nuts, etc.								
	6 Car Furnishings, Fixtures and Trimmings								
	7 Castings—Rough Brass	lbs.							
	8 Castings—Rough Iron and Steel	lbs.							
	84 Commissary Supplies								
	9 Couplers and Parts								
	10 Fence Posts and Fence Wire								
	11 Forgings	lbs.							
	12 Frogs	No.							
	13 Fuel	N. T.							
	14 Glass								
	15 Hardware (Shelf)								
	16 Hose	feet							
	17 Ice	N. T.							
	174 Interlocking and Signal Material								
	18 Iron—Bar and Sheet	lbs.							
	19 Lamps and Lighting Material								
	20 Locomotive Parts—Finished								
	21 Lumber and Timber	feet							
	22 Material in Course of Manufacture								
	23 Metals	lbs.							
	24 Miscellaneous								
	25 Oil—Car	gals.							
	26 Oil—Engine	gals.							
	27 Oil—Headlight	gals.							
	28 Oil—Miscellaneous								
	29 Oil—Signal	gals.							
	30 Oil—Valve	gals.							
	31 Paints								
	32 Piles and Stock Yard Posts	lin. ft.							
	33 Pipe and Fittings—Cast								
	34 Pipe—Wrought, and Fittings								
	35 Rail—Iron, Secondhand	G. T.							
	36 Rail—Steel, New	G. T.							
	37 Rail—Steel, Secondhand	G. T.							
	38 Rail—Steel, Scrap	G. T.							
	39 Rail Fastenings	lbs.							
	40 Scrap, not including Rail	N. T.							
	41 Springs—Car and Locomotive	lbs.							
	42 Stationery								
	43 Steel—Bar and Sheet	lbs.							
	44 Switches and Fixtures								
	45 Tie Plates, Brace Chairs, etc.								
	46 Ties—Cross	No.							
	47 Tires	lbs.							
	48 Tools								
	49 Trucks, Brake Beams and Pressed Steel Car Fittings								
	50 Tubes	feet							
	51 Waste	lbs.							
	52 Wheels—Car	No.							
	53 Wheels—Locomotive	No.							
	54 Steamship Equipment								
	55 Spare Machinery								

	CLASSIFICATION	Unit	Quantity *	Weight	Initial Cost	P & S Expense	Freight	Total Value	REMARKS
	1 Air Brake Material								
	2 Axles—Car	lbs.							
	3 Axles—Locomotive	lbs.							
	4 Bearings—Journal(Car and Tender)	lbs.							
	5 Bolts, Rivets, Nuts, etc.								
	6 Car Furnishings, Fixtures and Trimmings								
	7 Castings—Rough Brass	lbs.							
	8 Castings—Rough Iron and Steel	lbs.							
	84 Commissary Supplies								
	9 Couplers and Parts								
	10 Fence Posts and Fence Wire								
	11 Forgings	lbs.							
	12 Frogs	No.							
	13 Fuel	N. T.							
	14 Glass								
	15 Hardware (Shelf)								
	16 Hose	feet							
	17 Ice	N. T.							
	174 Interlocking and Signal Material								
	18 Iron—Bar and Sheet	lbs.							
	19 Lamps and Lighting Material								
	20 Locomotive Parts—Finished								
	21 Lumber and Timber	feet							
	22 Material in Course of Manufacture								
	23 Metals	lbs.							
	24 Miscellaneous								
	25 Oil—Car	gals.							
	26 Oil—Engine	gals.							
	27 Oil—Headlight	gals.							
	28 Oil—Miscellaneous								
	29 Oil—Signal	gals.							
	30 Oil—Valve	gals.							
	31 Paints								
	32 Piles and Stock Yard Posts	lin. ft.							
	33 Pipe and Fittings—Cast								
	34 Pipe—Wrought, and Fittings								
	35 Rail—Iron, Secondhand	G. T.							
	36 Rail—Steel, New	G. T.							
	37 Rail—Steel, Secondhand	G. T.							
	38 Rail—Steel, Scrap	G. T.							
	39 Rail Fastenings	lbs.							
	40 Scrap, not including Rail	N. T.							
	41 Springs—Car and Locomotive	lbs.							
	42 Stationery								
	43 Steel—Bar and Sheet	lbs.							
	44 Switches and Fixtures								
	45 Tie Plates, Brace Chairs, etc.								
	46 Ties—Cross	No.							
	47 Tires	lbs.							
	48 Tools								
	49 Trucks, Brake Beams and Pressed Steel Car Fittings								
	50 Tubes	feet							
	51 Waste	lbs.							
	52 Wheels—Car	No.							
	53 Wheels—Locomotive	No.							
	54 Steamship Equipment								
	55 Spare Machinery								

20,014

Operating Company _____ Division _____

Corporation _____ Main or Branch Line _____

State or Territory _____

RAILS

I. C. C. Const. Account No. 8

20,014

Date Compiled _____

†FROM EXISTING RECORDS
*FROM RECORDS OF ANALOGOUS CASES

	Location by Engineer Station or Mile	MAIN AND SECOND TRACK											REMARKS	SIDINGS AND SPURS											REMARKS
		Steel or Iron	Weight per Yard	Track Miles	Cost at Initial Point	Inspection and Handling	Freight per Ton	Rental and Repair of Equipment	Train and Engine Service	Total Cost per Ton	Total Tons	Total Cost		Steel or Iron	Weight per Yard	Track Miles	Cost at Initial Point	Inspection and Handling	Freight per Ton	Rental and Repair of Equipment	Train and Engine Service	Total Cost per Ton	Total Tons	Total Cost	Total Cost of Main Second Track Sidings and Spurs	

Holbrook Valuation Form. Material and Supplies, and Rails. Union Pacific.

Operating Company _____ Division _____

Holbrook Valuation Form. Material and Supplies, and Rails. Union Pacific.

20.045

Operating Company _____ Division _____
Corporation _____ Main or Branch Line _____
State or Territory _____

Transportation of Men and Material

I. C. C. Const. Account No. 32

20.045

Date Compiled _____
† FROM EXISTING RECORDS
* FROM RECORDS OF ANALOGOUS CASES

54

	FREIGHT			FREIGHT			FREIGHT		
	ITEM	METHOD OF OBTAINING	COST	ITEM	METHOD OF OBTAINING	COST	ITEM	METHOD OF OBTAINING	COST
	Hay			Telegraph Poles			Engineers		
	Grain			Telegraph Material			Engineers' Assistants		
	Stores						Inspectors		
	Horses and Mules						Superintendents		
	Wagons			Signal Apparatus			Time Keepers		
	Plows and Scrapers						Store Keepers		
	Dump Cars						Material Agents		
	Steam Shovels						Clerks		
	Tents						Material Yardmen		
	Temporary Buildings			Water Service Material					
	Station Supplies								
	Rails						Contractors		
	Track Fastenings						Foremen		
	Frogs and Switches						Paymasters		
	Ties						Agents and Operators		
	Switch Ties			Fencing Material			Section Men		
	Lumber						Labor Agents		
	Piling						Laborers		
	Bridge Iron						Firemen		
	Boilers						Train Crews		
	Pumps			Roadway Tools			Engine Crews		
	Stationary Engines						Machinists		
	Cast Iron Pipe						Well Borers		
	Wrought Iron Pipe						Water Service Men		
	Wooden Pipe						Signal Men		
	Concrete Pipe			Bridge Tools					
	Coal								
	Fuel Oil			Well Rigs					
	Lubricating Oil								
								Total	

20.016

Operating Company _____ Division _____
Corporation _____ Main or Branch Line _____
State or Territory _____

TRACK FASTENINGS

I. C. C. Const. Account No. 19

20.016

Date Compiled _____
† FROM EXISTING RECORDS
* FROM RECORDS OF ANALOGOUS CASES

	LOCATION AND LENGTH OF SECTION	SPLICES			TRACK BOLTS		TIE PLATES		SPIKES		NUT LOCKS		RAIL BRACES		CHAIRS		MISCELLANEOUS		Total Weight and Total Initial Cost	Inspection and Handling	Freight for all Fastenings	Rental and Repair of Equipment	Train and Engine Service	TOTAL COST	REMARKS
		KIND	Number and Weight per Pair	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost	Weight Each and Number	Total Weight and Initial Cost							

Holbrook Valuation Forms. Transportation of Men and Material. Track Fastenings. Union Pacific.

20,036

Operating Company.
Corporation.
State or Territory.

Division.
Main or Branch Line.

Electric Power Plant

I. C. C. Const. Account No. 28

20,036

Date Compiled.

†FROM EXISTING RECORDS
*FROM RECORDS OF ANALOGOUS CASES

BUILDINGS

Location and Description	ITEM	Kind	Unit	Number	Price	Initial Cost	Weight	Freight	Labor	Train and Engine Service	Rental and Repair of Equipment	Use and Repair of Tools	Freight on Animals and Plant	COST
	Right of Way and Real Estate													
	Grading and Excavation													
	Foundations													
	Stonework													
	Brickwork													
	Woodwork													
	Glazing													
	Hardware													
	Roofing													
	Painting													
	Heating													
	Lighting													
	Domestic Water Supply													
	Drainage													
	Furniture and Fixtures													
	Platforms													
	Fencing													
	Paving													
	Total for Buildings													

Steam Equipment (Boiler Room)

	Foundations for Machinery													
	Boilers													
	Stacks													
	Feed Pumps													
	Economizers													
	Feed Water Piping													
	Coal Conveyors													
	Fuel Oil Piping and Pumps													
	Steam Piping													
	Coal Bins													
	Oil Tanks													
	Hot and Feed Wells Etc.													
	Total Boiler Equipment													

Steam Engine and Equipment (Engine Room)

	Foundations													
	Engines													
	Condensers													
	Circulating and Air Pumps													
	Piping, Live Steam													
	Other Piping													

STEAM ENGINE AND EQUIPMENT Continued

Location and Description	ITEM	Kind	Unit	Number	Price	Initial Cost	Weight	Freight	Labor	Train and Engine Service	Rental and Repair of Equipment	Use and Repair of Tools	Freight on Animals and Plant	COST
	Valves and Fittings													
	Lubricating System													
	Belting													
	Crane													
	Total Engine Equipment													

Reservoirs and Hydraulic Development

	Clearing													
	Dams													
	Gates and Regulating Works													
	Diversion Dams													
	Head Gates, Screens and Machinery													
	Canals													
	Pipe Lines													
	Flumes													
	Tunnels													
	Forebay													
	Penstocks													
	Sand Boxes, Waste Gates and Spillways													
	Total Hydraulic Equipment Outside Power House													

Power House Equipment, Hydraulic and Electric

	Foundations													
	Waterwheels													
	Governors, Valves and Fittings													
	Generators													
	Exciters													
	Switchboards													
	Lightning Protection													
	Cables and Wiring													
	Transformers													
	Crane													
	Fixtures													
	Total													
	Grand Total													

Holbrook Valuation Form. Electric Power Plant.

Operating Company ..... Division .....
Corporation ..... Main or Branch Line .....
State or Territory .....

Station Buildings and Fixtures
I. C. C. Const. Account No. 15

Date Compiled .....

	Description, Dimensions and Class	BUILDING AT — Item	Kind	Unit	Number	Price	Initial Cost	Weight	Freight	Labor	Train and Engine Service	Rental and Repair of Equipment	Use and Repair of Tools	Freight on Animals and Plant	Cost
		Grading and Excavation													
		Foundation													
		Stonework													
		Brickwork													
		Woodwork													
		Structural Steel													
		Roofing													
		Glazing													
		Hardware													
		Painting													
		Heating													
		Lighting													
		Water Supply													
		Drainage													
		Trains and Trains													
		Platforms													
		Fencing													
		Total													

Holbrook Valuation Forms. Station Buildings and Fixtures.

Filing cabinets for maps, drawings or correspondence.
Ticket cases, office counters, partitions.
Other office furniture.
Carpets.
Rugs.
Pictures.
Wall maps.
Other maps, drawings or prints.
Window awnings and shades.
Signs.
Typewriters.
Adding or similar machines.
Phonographs, dictographs, or other similar machines.
Telephones or inter-communicating systems.
Blue print machines.
Cameras.
Books, pamphlets, etc.
Advertising folders and other advertising matter.
Tickets (intrinsic value only).
Postage stamps.
Office stationery, pens, pencils, inks.
Dating and other stamps.
Miscellaneous office supplies.

The above are columned down the page. To the right are columns for, number of articles, original cost, cost to reproduce, details, remarks.

OFFICE FURNITURE AND FIXTURES IN CERTAIN GENERAL OFFICES AND OUTSIDE AGENCIES ON AND OFF THE LINE OF ROAD

Apportionment to corporations.—Per statement issued by deputy Comptroller, Union Pacific System, Date ....., and per telegram from Auditor, ..., addressed to E. Holbrook, Special Engineer. And apportionment to states, either on road mileage within each state for each corporation, or state in which agency is located.

Then follows across the page the columns for the states headed by the name of the state, as, Iowa, Nebraska, Wyoming, etc. And down the left hand side of the page are the names of the corporations with two lines allowed to each, one for original cost and one for cost to reproduce, thus:

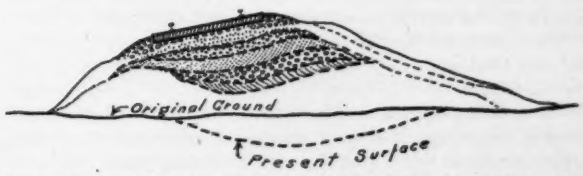
Union Pacific Railroad.
Oregon Short Line Railroad.
Oregon Railroad & Navigation Co.—Rail Lines.
Oregon & California Railroad.
South Pacific Coast Railroad.
etc., etc.

WATER STATIONS
I. C. C. Construction Account No. 22
Water Station at .....

In columns from left to right:
General description.
Item.
Kind.
Unit.
Number.
Price.
Initial cost.
Weight.
Freight.
Labor.
Train and engine service.
Rental and repair of equipment.
Use and repair of tools.
Freight on animals and plant.
Cost.

Fire protection equipment may be included under the head of buildings or under the head of water supply stations. But owing to the fact that the pipes are under ground, and out of memory and record, it may be well to have a sheet just for the purpose of tabulating the value of fire protection plants separately. Most

Cross Section Showing Expansion from Original Fill and Ballast.



Cross Section Showing Original Ground, Fill and Ballast, Also Present Surface.

Cross Section Showing Layers of "Chat" Ballast.

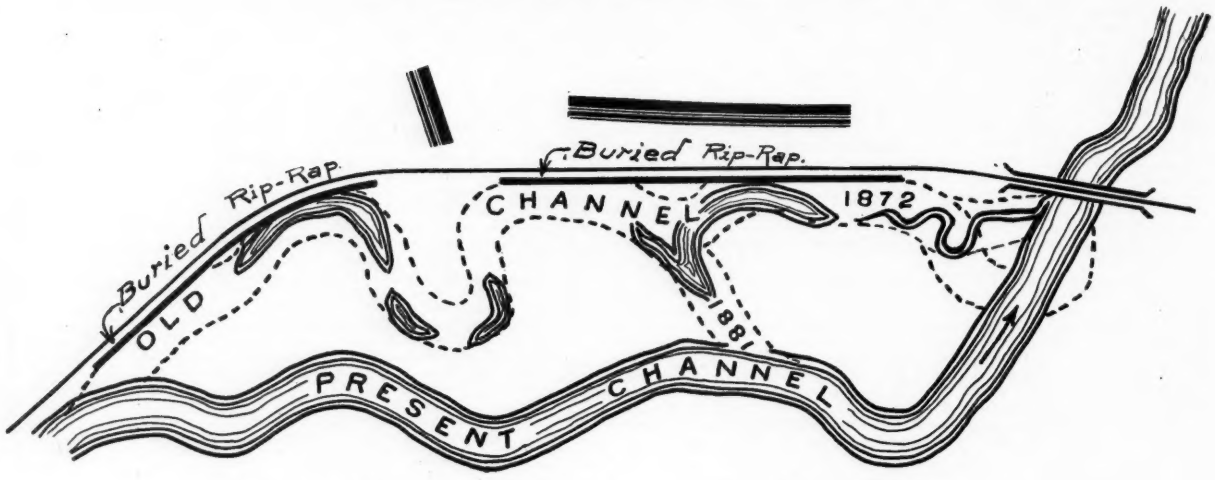


Fig. 1. Valuation of Railroads. Rip Rap Buried and Forgotten When Stream Changed Channel.

every railroad has fire protection systems, and sometimes they are extensive plants reaching yards, car shops, and lumber sheds, often far apart, miles of pipe merely indicated by a hydrant here and there, which the valuator of one form of buildings supposes the valuator of another class will look after. On one of our most prominent roads they were omitted in what was supposed to be their complete and final valuation, but now have been added as a sort of postscript down at the bottom of several sheets.

The same may be said of the compressed air service and steam heating plant for yards. They may be represented by miles of pipe and thousands of dollars, but because these can't be seen they may be overlooked.

Realizing the danger of omission, one large railroad system has inaugurated the plan of sending their best men out as pilot engineers with the federal valuation parties, and they use the men who have been the longest with the road, those whose memory runs back the farthest. Their minimum pay is $200 per month and expenses. The recollection of many items placed in the ground 20 years ago, but now hid from view, may easily repay the company for employing such men.

Another road has adopted the plan of cross-cutting the embankments; actually digging a trench across so as to expose the different layers of gravel and filling, and getting credit for the cost. Some of the results are surprising and justify the expense, exposing as they do several layers of ballast three to five feet thick, and in one case of "chats" ballast in a waterholding clay embankment the depth of "chats" was seven feet. These different layers may be called a maintenance charge, but they show where the money has gone, increase the stability, aid the drainage and are an addition and betterment. Three figures are here given illustrating the results of cross-cutting the embankments.

Among the various items that may be overlooked if not guarded against by the memory of some one are such things as:

Piling to hold a sliding bank.
Culverts filled over.
Riprap filled over.
Obsolete facilities, such as old yards and former roadbeds.
Ditches, drains, dams, channel changes of streams.
Piping for water works, heating, and air-testing plants.

Figure No. 1 represents a case of ripraping costing thousands of dollars, now lost to sight, filled over, and unnecessary because the river that once washed the toe of slope for a mile has changed its channel, but that all cost money, and the stone are still there, a latent force of protection against washout and wreck, when in the course of another decade the river swings back again.

As valuation is for showing up the cost of the plant as nearly as it may possibly be determined, and no more and no less, and as a railroad stretches out for miles and miles, it is not the compact proposition that any other industry is, and the great danger is that undervaluation will result. It will be out of the question to make up for deficiencies in omission by slightly increasing known quantities, or raising just a little the unit prices, prices per cubic yard or per pound. Neither the managements of the railroads or the various commissions will stand for this. Therefore the proper way is to use every care that nothing is omitted, and the proper way to provide for this is to have a space for everything—to have the office forms and the field note books complete and systematized. Many, many, are the roads that have gone at this important business on the plan of "let the thing develope itself," resulting in tabulation via the typewriter from notes on small slips, plain field books, and station plats. And some of these valuations are now bound in book form for the final sheets, but to one experienced in the business they seem to speak plainly as if the chief engineer said it himself: "This is not a valuation; this is a record of the memory of my subordinates."

THE EXTERMINATION OF RODENTS.

The Queen & Crescent Route, under the direction of T. C. Powell, vice president, has inaugurated an active campaign against rats in order to avoid the possibility of spread of the bubonic plague. The campaign is immediately under the direction of Jas. M. Arnold, special freight agent.

The bubonic plague was brought to this country with foreign shipments of goods and the first appearance was in New Orleans. Great efforts are being made to suppress the disease at that point. This is the fourth year that the disease has broken out in the United States.

Two drugs are used in killing the rodents. One is the Pasteur virus, which is not poisonous to anything but rats and mice. Dogs, cats and people may eat the virus without harm, but it gives to each rat a fatal disease. The rodent lives about five days after eating it. After that every other rat that comes in contact with the affected one becomes inoculated with the disease, which spreads rapidly to a whole community.

FULL CREW BILL SWAMPED.

Complete official figures show the majority given by the state of Missouri against the Full Crew Bill to be three times as great as the estimate based on early returns. There were 324,085 votes against and 159,593 in favor, a majority of 164,492 in opposition to the bill, making the vote more than two to one against it. Outside of the three principal cities, St. Louis, Kansas City and St. Joseph, the measure received only 86,660 votes in the state and was beaten by a ratio of about three to one. The farmers in every section voted almost solidly against it.

PUBLIC RELATIONS OF THE BALTIMORE & OHIO.

The question of public relations between the Baltimore & Ohio railroad and the communities served by its lines is one of absorbing interest to the management, as indicated by a circular which has been sent to all officials, agents and other representatives of the road, urging them to exert every effort to promote good will by bringing about a fair understanding of the railroad problems, while at the same time according due consideration to public rights.

Representatives of the railroad have been instructed to keep in touch with matters of state and municipal government, as well as with the activities of business organizations, so that where railroad questions are involved the company may secure a hearing when propituous for it to do so. The sense of the circular is that the local representatives of the Baltimore & Ohio shall act in a representative capacity for the management.

At meetings of town councils, trade organizations or citizens the railroad representatives are urged to enter their appearance and give consideration to the questions which come up. In this way the management aims to put itself in intimate touch with public opinion in order to work along co-operative lines with the communities upon whom it depends for revenue.

Agents and others are urged to keep themselves informed through the medium of the local press and forward such articles as may be of interest to superiors. The purpose of the Baltimore & Ohio policy is to extend the plan adopted recently of tendering to the various communities the expert services of its engineers, transportation, traffic, industrial, and other officials free of charge in working out their problems. Officials of the Baltimore & Ohio are called into consultation often on problems concerning water works improvements, street construction, erection of buildings, etc., the aim being to give the communities the benefit of every possible assistance.

The present policy of railroad management which has as its foundation co-operation between transportation interests and the people they serve suggested the circular which is being sent to Baltimore & Ohio representatives.

CANADIAN NATIONAL COMMISSION.

The Government of Canada will appoint a National Commission in the near future to investigate the whole question of western freight rates and the retention of traffic for the Canadian railway systems. A conference held a few weeks ago between the Canadian Manufacturers' Association and the organized farmers of Western Canada resulted practically in a manifesto to the manufacturers that the traffic question was the biggest problem of the day in Canada. Although the object of the manufacturers was to persuade the grain men to enlarge their operations, encourage a bigger population and hence create a demand for "made in Canada" goods, the net result of the discussion was not very satisfactory; the farmers said in effect: "Under the present conditions the profit in grain growing is too meagre to encourage expansion. The real starting point of a new growth is a new freight schedule and better banking facilities."

Long hauls and light freight traffic during most of the year render freight rates costly. It is the old story of the necessity of a high rate of profit on a relatively small turnover. An abundance of freight traffic will alone adequately cut freight charges.

A point of the highest importance is that the Canadian railways are in danger of losing a large proportion of the future carrying trade of the Canadian West that naturally should be theirs. During the past few years the Great Northern Railway that traverses the West south of the boundary has built spur lines from some seventeen points in Canada between the Pacific and Lake Huron with a view to securing the carrying trade of the Canadian western producers and thus offer a very real competition with Canada's three transcontinentals. These railway spurs have proved a boon to the Canadian producer as they have served to carry their natural products to the consumer to the south of the line. While this is true, the task before the National Commission will be to adjust conditions of trade and commerce and transportation with a view to securing as much as possible of the carrying trade of Canadian products for eastern shipment on Canadian lines.

Canada today has rather poor marketing facilities from coast to coast. It has been pointed out again and again by experts that cold storage plants will have to be placed at suitable points. The fruit industry of the country is poorly provided for. The inability of the fruit growers of Eastern Canada to market their abundant apple crop this year presents an example of the inefficiency of marketing machinery.

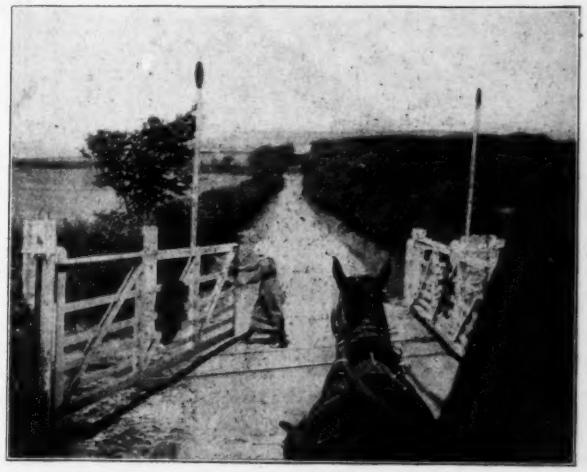
The natural focal points of the various provinces are those from which the Great Northern has taken care to run its lines and to project routes which the future will likely see completed: Vancouver and Prince Rupert for British Columbia; Edmonton and Calgary for Alberta; Regina, Saskatoon and Prince Albert for Saskatchewan; Winnipeg and Brandon for Manitoba; Fort William and Cochrane for New Ontario.

UNIQUE "SAFETY DEVICES" IN ALBION.

By Felix J. Koch.

Signs, warnings, what you would to the contrary—when a man is in a hurry, he will take a short-cut—and when a man with a team or in an automobile is in a hurry he will drive across a railway right-of-way and chance it, just so long as no train is actually in sight.

Recognizing which fact, over in sections of Albion interesting, simple devices have been installed—in places—as aids to "safety first."

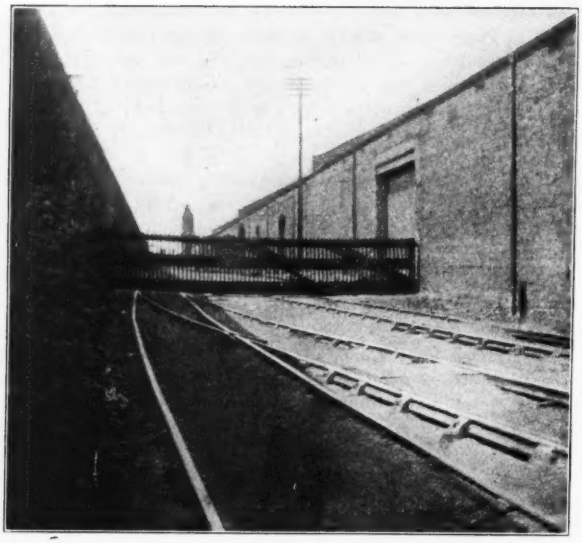


Highway Crossing Gate, England.

These take the form of broad, paling gates, that swing the width of the tracks, and, again, the width of the road. Instead of the gates merely blocking the road to crossers,—as our own railway gates do;—and then letting the locomotives tear by regardless, officialdom on the English railways remembers that keepers of such gates are human and hence not infallible; that sometimes telegraphs may be out of order or misunderstood and the like. So, instead of closing their eyes to the chance of the road-gate not being down, they have this simple substitute:

When the road is open to travel, i. e., when no train is due, the gate is swung clear across the track, rather than raising aloft, as do our own. When the road is closed to travel, it is swung across this, and the track is clear.

If, now, by some mischance, the gatekeeper be directed, or some unexpected train comes by, if signals or telegraph have failed and the like, the engineman sees the gate across his track,—



Highway Crossing Gate. Blind Crossing, England.

Standard Crossing Sign American Railways, for Comparison with English Methods.

there's a big red bull's-eye painted on it, visible from afar,—and it's up to him, then, to slow down and stop his engine, in order to open the gate and get his right-of-way. The idea recommends itself to other places where crossroads accidents are so commonplace.

STRUCTURES.

The Atlantic Coast Line is preparing to rebuild its bridge over the Hillsboro river, near Tampa, Fla., plans having been approved by the war department. It will be of bascule type.

John E. Grenier, consulting engineer, Baltimore, Md., will prepare plans and specifications for the new bridge to be constructed over the Brandywine at Wilmington, Del., in place of present B. & O. railroad bridge.

The Chicago & Northwestern will build a new suburban passenger station at Monticello and Central Park avenues, Chicago, in March. Citizens have been asking this improvement for more than a year. It is planned to call the new station Parkside.

The Chicago, Rock Island & Pacific has prepared plans for a passenger station at Kansas City, Kan.

The directors of the Union Station Co., Chicago, will meet January 12 and some action will be taken with reference to construction of the proposed new terminal, as the time for beginning this work expires March 23.

The Erie will commence work remodeling its station at Cleveland, Ohio. Geo. A. Rutherford Co. have the contract.

The Grand Trunk Ry. has awarded the contract for the construction of a new bridge at South Bend, Ind., to Charles Gordon.

Bids received by Capt. Nicholson, of the Grand Trunk Pacific, Vancouver, B. C., for the reconstruction of the superstructure work of the Grand Trunk dock at the foot of Marion street, have been submitted to the Winnipeg office. The work is estimated to cost $175,000.

The Kansas City Southern will build a new passenger station at Siloam Springs, Ark., in the near future. The building will be 24 ft. by 148 ft. in area and one story high.

The Monongahela Valley Traction Co. contemplates the erection of a $350,000 power plant as an anxiliary to the steam plant. The new plant will be located at Hutchinson.

Three grade crossings on St. Lawrence and Adirondack divisions of the New York Central at Remsen, N. Y., have been ordered eliminated. The cost is to be divided equally between railroad and the state highway department.

The Northern Pacific has applied for a charter for the Northern Pacific & British Columbia Ry.

The Public Service Commission of New York has ordered the construction of a plate girder bridge, 67 ft. long, with an 18-ft. roadway and two 5-ft. sidewalks on Eastern boulevard over the Carthage branch of the New York Central tracks at Watertown, N. Y.

The freight terminal of the Oregon-Washington Railroad & Navigation Co. at The Dalles, Ore., will include six switching yard tracks, a 12-stall roundhouse, a machine shop 40 by 40 ft., a power house 40 by 60 ft., a storehouse 40 by 80 ft., a water tank, coaling plant, cinder conveyor, turntable, etc. The estimated cost is $200,000.

The Pennsylvania has submitted plans to the board of city commissioners of Trenton, N. J., for the construction of a number of permanent bridges over the Delaware & Raritan canal.

The Pennsylvania is asking for bids on 17,600 tons of structural steel for bridge construction during 1915. The company also asked for bids on 1,270 tons of steel for use in re-enforced concrete work.

The Philadelphia & Reading terminal at Camden, N. J., was totally destroyed by fire on January 4 at a loss of $150,000. Over thirty passenger and Pullman cars were also destroyed.

The Seaboard Air Line and the St. Johns River Terminal have awarded a contract for construction of the Duval street viaduct at Jacksonville, Fla., to Hillyer & Sperring Co., Jacksonville.

The Southern will construct a new overhead concrete bridge on North Church street, Spartanburg, S. C., to replace a wooden structure.

The Southern Pacific has agreed to construct a steel and concrete viaduct to cost about $55,000, to eliminate the grade crossing over Holgate street, Portland, Ore.

The Trans-Mississippi Terminal will begin work on the proposed new terminals at New Orleans, La., soon. The company is controlled jointly by the Texas & Pacific and Missouri Pacific-Iron Mountain system.

The Wheeling & Lake Erie and Newburg & South Shore railroads are preparing plans for new bridges across the Cuyahoga river at Cleveland, O. The opening of the upper river for navigation makes changes necessary.

RAILWAY CONSTRUCTION.

The Atlantic Harbor will be incorporated to construct a line between Jacksonville, Fla., and Fort George Island, approximately 30 miles in length.

The Cairo, Truman & Southern, it is reported, contemplates building a 20-mile extension from Weona to Earle, Ark.

The California Southern is planning to let grading contracts this month for 40-mile line to connect Blythe, in Palo Verde Valley, with Blythe Junction in Santa Fe System.

The Canadian Northern and the Canadian Northern Ontario have applied to the Canadian parliament for an extension of time in which to build proposed branch lines.

CONCRETE DEPARTMENT

Cold Weather Concreting.

DOES your superintendent send in reports like the following during *cold snaps?* "No concrete poured today, no provision having been made to heat the aggregates; expect to have apparatus in shape in a few days so as to be able to pour continuously." If he does, there is something wrong with your organization and it should be *righted at once* if winter concrete work is to be carried on economically. Plant cost, superintendent's salary, overhead charges, etc., go on just the same whether any work is done or not and it therefore behooves the contractor or the construction department to see that such delays are avoided.

After the first of November (in this locality) cold weather can be expected any time and apparatus for heating water and aggregates, and materials for covering concrete should be kept in readiness for almost instant use, then there will be no delays due to *cold snaps.* Besides this the morale of the organization will be greatly influenced with the result that better work will be turned out. Nothing gives a force of men more encouragement and vim than the confidence that the men in charge are always in readiness to meet almost any emergency; and then again nothing is more disgusting and demoralizing to them, than needless delays in cold weather which breed discontent and dissension in an otherwise excellent organization.

If you wish to do winter concrete work you can, by making provisions to heat materials and cover deposited concrete, surround yourself with an organization of good men, in fact, men who have a real object in life and not those who think only of today, for the "floater" does not care to work in winter. In this way winter concrete work can be carried on almost as economically and probably just as profitably as in summer; and what is more, very little will be expended in organizing good gangs every spring, which is not the case with the periodic contractor.

Wiring Reinforcing Bars at Splices.

IN the early days of the reinforced concrete industry the wrapping of spliced ends of reinforcing bars with many turns of wire was commonly accepted as good practice, it being supposed that such wiring aided materially in developing the proper strength of splice. Numerous laboratory tests have in the meantime proven beyond a doubt the utter fallacy of this belief. It is therefore rather surprising that some text books, designing engineers and railroads still force this mistaken idea to the front by specifying securely wired splices wherever reinforcing bars are spliced.

In some cases the lap of bars was cut down materially on account of the fact that the wiring was assumed to transmit some of the stress. This practice is "courting disaster," since no wired splice can be made strong enough to prevent considerable slip (that is enough to rupture the concrete) when stress is applied, before the wired splice comes into action. Laboratory tests made by various recognized authorities prove this.

If the wrapping of spliced ends of bars with 15 or 20 turns of wire will not justify the cutting down of the necessary lap length to develop the bar in bond, why spend money for labor and material for a useless purpose. It may be well to wire the bars together with a few small pieces of wire to hold them in place but to envelop them in a wire coil is not economical, to say the least.

No more efficient splice has yet been developed for reinforcing bars, than the simple method of lapping them a certain number of diameters (depending on the type of bar), to develop the splice by bond between concrete and steel, and it would be well for many engineers to bear this in mind when designing concrete structures.

Architectural Treatment of Concrete Surfaces.

WHEN concrete was first used nothing was done toward obtaining a surface finish which would be pleasing to the eye and the appearance of some of the early structures built of concrete proves that no thought was wasted on architectural details, most architects considering it beneath their dignity to *dabble* in concrete. Nowadays, however, the conditions have changed entirely, for there are very few structures built of concrete, in the design of which, no thought is given to architectural treatment. Architects and engineers are beginning to realize that to produce structures of reinforced concrete that are good in all respects, they must work together and the results are gratifying. Sometimes an architectural detail must be sacrificed for structural reasons or local conditions and vice versa. To meet this condition of affairs the architect and engineer should have a common interest —that of better concrete—and not an antagonistic attitude as has often been presented whenever one profession *seemed* to encroach on the territory of the other.

That the architects realize that concrete is a material worthy of architectural treatment even in bridge work is clearly shown by an article which appeared in the *American Architect* some months ago, on "The Architectural Treatment of Concrete Surfaces," based on the designs of concrete structures of the D., L. & W. R. R., Mr. F. J. Nies, architect. The writer says in part: "Economic conditions are, after all, probably the most potent factors in directing our architectural destinies. * * * It was the consideration of reduced cost that led the railroads and the other concerns interested in large engineering works to develop the use of concrete in massive construction. * * * The economic and other advantages having directed attention to concrete, its use was for a long time devoted almost exclusively to the more massive forms of construction,—to foundations, piers and heavy retaining walls. But as economic conditions under certain circumstances became more insistent and some of the inherent virtues of the material became more obvious, the attention of a few architects was perhaps unwillingly drawn to the architectural treatment of a material which clients importuned them to use. Naturally the first tendency to make the surface of concrete simulate that of building stone was too strong to resist, even by those who most loudly preached the policy of honesty in everyday affairs. To mould concrete in blocks so that its face shall have even the mechanical form of stone ashlar, or to simulate joints

on the surface of a monolithic wall for the same purpose, is only an obvious and quickly resented attempt at deception. Such treatment not only asserts a quality which is lacking in concrete, but denies the user the advantage of its unique qualities. These are plasticity, permitting it to be cast or moulded in forms of any size and almost any shape, and its composition of cement and aggregate making possible a great variety in surface treatment. Perhaps the greatest opportunities for the architectural treatment of concrete are in the broad wall surfaces of monolithic construction. * * * Among the good examples in this recent architectural treatment of concrete are some stations and bridges on the lines of the Lackawanna Railroad, for the design of which their architect, Mr. F. J. Nies, was chiefly responsible."

After describing in detail the surface treatment on some handsome bridges and stations, at Montclair, Bloomfield, Watsessing and other localities in New Jersey, the writer closes with the following:

"Concrete can no longer be regarded as a gross material, suited only for heavy, massive construction. It is a plastic material and is composed of an aggregate which, when properly selected, makes possible an infinite variety of effects in an infinite number of forms. As the illustrations indicate, there has been recently a considerable appreciation of its possibilities, but the future architect will undoubtedly develop these possibilities more broadly."

We have devoted considerable space (justly, we think) in these columns from time to time, illustrating and bringing to the attention of the engineer and architect in railway service the great possibilities of concrete for architectural as well as structural treatment, and it is indeed a pleasure to have one of our contemporaries in the architectural field present the matter so forcefully to its readers. As in the past, our aim is to give our readers as much information regarding architectural treatment of concrete in various structures as possible, and with this in mind we describe in this issue a very beautiful example, a bridge recently completed at 66th Ave., Philadelphia, over the North Pennsylvania R. R. Although not a railroad bridge it merits the attention of bridge engineers on account of its interesting architectural treatment, viz., the use of colored tile panels in the parapets.

This is not the first time that tile inserts have been made use of in the decoration of concrete surfaces, but we do believe that more care was exercised in bonding the tile panels to the concrete than in any previous case, with the result that the difficulties previously experienced in this kind of work were avoided. In some early work of this character recesses larger and of different shape than the tile panels were left in the concrete and when the cement grout backing and surrounding the tile had hardened, the surface cracked very badly and spoiled the otherwise excellent appearance of the structure. In this case no special care was taken to bond the backing to the main body of concrete and this was no doubt one of the contributing causes to the unsuccessful outcome of the experiment. Gradually, as more and more concrete is used, designers begin to realize that in many cases it is the *supposedly minor details* which require the most attention in order to insure a structure free from defects.

DUSTLESS CONCRETE FLOORS.

A process for producing dustless concrete floors has been evolved by P. M. Bruner of St. Louis, and has been used in several buildings in Chicago which have been in service two or three years with excellent results.

The top finish of the floor is put down in the usual manner, then burlap is spread over the surface and a dry mixture of cement and sand of the same proportions as the top finish is lightly spread on the burlap to a depth of ½ inch. The excess water amounting to 25 or 30 per cent is taken up by the covering through capillary attraction in about 20 to 30 minutes. At the end of this time the covering is lifted by picking up the burlap and the mixture dumped in the mixing box and used for the next batch.

The surface of the floor after this treatment is very stiff, no impressions being made by walking on same, or by troweling for final finishing. By this method of taking up the excess water the usual disturbing of the setting cement while finishing is avoided and also consequent dusting of the floor.

In the usual process the finishing cannot be proceeded with until the cement has begun to set and the excess of water has evaporated or been taken up by the base. Then when troweling is begun the setting process is disturbed and excess water tends to collect on the surface and drown the cement. Now when the floor is subjected to wear, this film of "drowned" cement wears off and a sandy, very abrasive surface is left which is always dusty.

This new process of laying dustless cement floors is controlled by the P. M. Bruner Granitoid Company of St. Louis, Missouri.

HYDRATED LIME IN CONCRETE BRIDGE CONSTRUCTION.

In building the San Jacinto Street Bridge at Houston, Texas, an arch bridge with a total length of 322 ft., hydrated lime was used to replace 10 per cent of the cement of a 1:5 mixture of concrete, the aggregate used being a mixture of fine gravel and sand.

The William P. Carmichael Company who built this structure states "that hydrated lime was used in concrete for making hand rail on this bridge with three purposes in view: 1. To facilitate easy handling and filling of moulds. 2. To allow moulds to be easily removed from concrete after setting. 3. To give concrete product light color. We are pleased to state that we got the above results satisfactorily from the use of hydrated lime in this concrete, and the general quality of work speaks for itself in the general appearance of the structure."

AMERICAN CONCRETE INSTITUTE CONVENTION AT CHICAGO, FEB. 9-12, 1915.

The 11th annual convention of the American Concrete Institute will be held at the Auditorium Hotel, Chicago, Feb. 9-12, 1915. Sessions will be held at 10 a. m., 3 p. m. and 8 p. m.

The subjects taken up the first day will include concrete roads, sidewalks and bridges. Concrete and reinforced concrete tests and design will be the subjects for second day. The third day will be given over to the consideration of concrete in art and architecture, including architectural design, dimension and art stone and surface treatments. In the evening the 10th anniversary banquet will be held. The last day will be devoted to concreting plants, including plant management and costs, the design and cost of wood and metal forms, including methods of placing materials together with their selection and proportioning.

Changes in the by-laws which will tend toward more popular control and possibly a more lively activity of large membership, will be considered.

The Southern, in connection with its proposed expansion of yards at North Birmingham, Ala., plans the removal of its Avondale shops to the Finley yards. The concentration of all terminal work at the Finley yards is expected to facilitate shipments. It is rumored that later the terminal facilities and shops of the Alabama Great Southern, controlled by the Southern, also may be moved to the Finley yards.

Unit Built Overhead Highway Bridges of Two Different Types. D. L. & W. R. R.

DESCRIPTIVE OF 35-FT. SPAN BRIDGES BUILT IN A CENTRAL YARD, HAULED 60 MILES TO SITE AND ERECTED IN THREE HOURS AT VERY LOW COST.

By A. M. Wolf, C. E.

General.

On most of our larger railroads concrete has become the standard material for the construction of overhead highway bridges except in cases where conditions are especially unfavorable to the use of concrete, as, for instance, where materials and labor are not located conveniently. Even in such cases it is interesting to note that the problem can be readily and economically solved by building the structures in units in a central yard, hauling same to the site on cars and erecting with a locomotive crane or derrick mounted on a car.

The engineering department of the D. L. & W. R. R. solved the problem of how to economically build highway bridges of reinforced concrete to replace old wooden structures in the manner outlined above. No facilities being available to build the bridges in the field at a place 60 miles from a division point, without involving a considerable expenditure for a comparatively small amount of concrete it was decided to build them in unit sections and set them in place in the field on the old abutments much the same as if built of structural steel. The bridges were therefore designed with the idea in mind to keep the dead weight a minimum to facilitate transportation and erection.

The bridges decided upon are of two types, viz.: *Type A*,—Tee-beam units with Vierendeel truss hand-rails to span two tracks, and *Type B*,—Flat slab units for double track crossing with an intermediate support between tracks.

Designing Loads and Unit Stresses.

Both types are designed to carry a 12-ton traction engine or 100 lb. per sq. ft. with 25 per cent impact, whichever load gives the

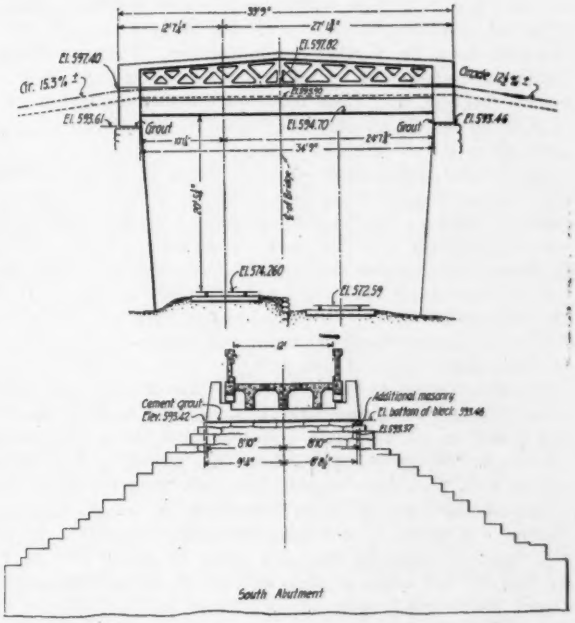


Fig. 1. Type A. Overhead Highway Bridge of Concrete. D. L. & W. R. R.

used were: Tension in high carbon steel, 16,000 lb. per sq. in.; compression in concrete, 650 lb. per sq. in.; shear, 50 lb., and bond, 100 lb. per sq. in.

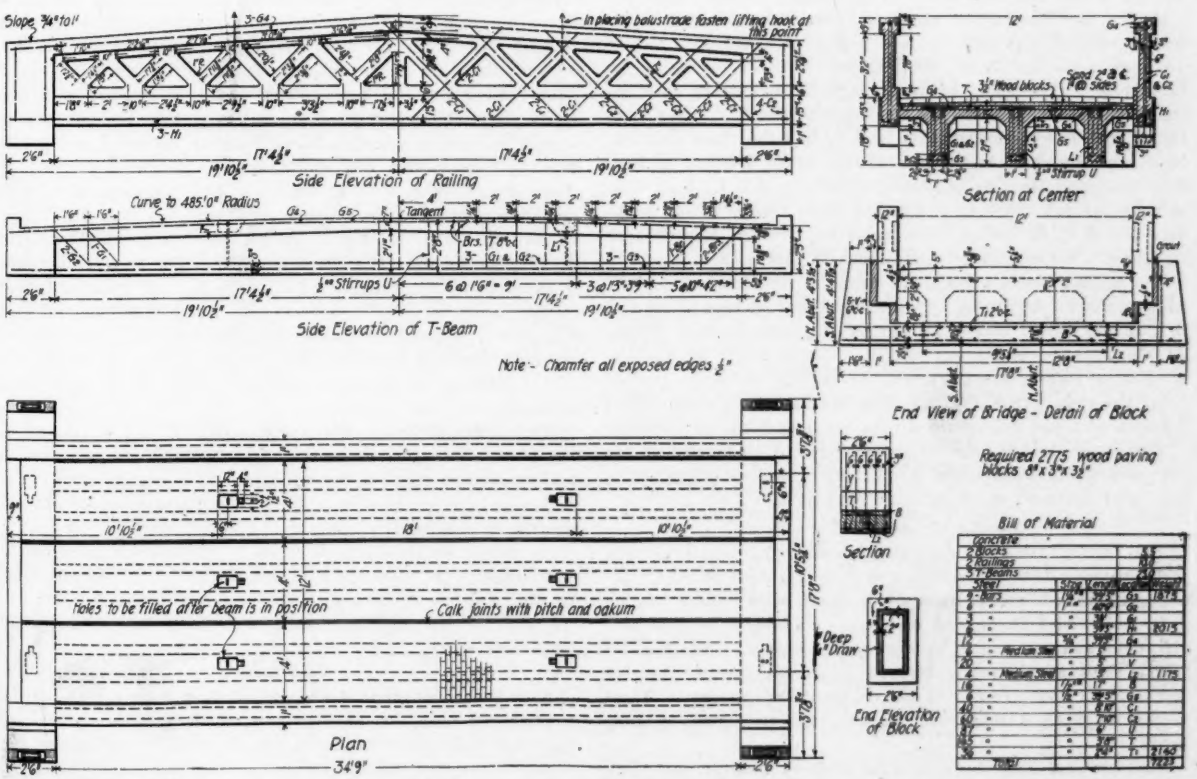

Side Elevation of Railing
Side Elevation of T-Beam
Section at Center
End View of Bridge - Detail of Block
Plan
Section
End Elevation of Block
Bill of Material
Holes to be filled after beam is in position
Calk joints with pitch and oakum
Note:- Chamfer all exposed edges ¾"

Fig. 2. Details of Type A Highway Bridge: Tee-Beam Units, Trussed Handrails and Bearing Blocks of Concrete.

Details of Design—Type A.

The *Type A* bridges, as previously noted, are composed of three Tee-beam units as main carrying members and Vierendeel truss hand rail units also built of concrete, these later adding greatly to the appearance of the structures. (See Fig. 1.) In order to provide a good bearing on the old masonry abutments unit bearing blocks of reinforced concrete were cast to form seats for Tee-maximum stress for member in consideration. The unit stresses beams and trusses with vertical end pieces to hold the latter in place. (See Fig. 2.) These blocks were leveled up, and grouted in place on the old masonry and the other units swung in place upon them.

The bridges have a width of 12 ft. inside of handrails which are 1 ft. wide and have a clear span of 34 ft. 9 in. between abutment blocks. The roadway is formed by three Tee-beams with 4 ft. flanges 7 in. thick and a stem 1 ft. wide and 2 ft. 1 in. below slab at center and 1 ft. 8⅜ in. below at support, the tops of beams being curved to a radius of 485 ft., thus providing for drainage of deck. The ends of beams for a length of 2 ft. 6 in. over bearing blocks are made solid with a projecting curb to retain the wood block pavement.

The main reinforcement of beams consists of three 1¼ in. sq. bars in bottom layer and three 1 in. sq. bars bent up at each end placed in another layer 3 inches above the straight bars. One bar is bent up at a point 3 ft. from support and the other two at 1 ft. 6 in. from support. In addition to the shear reinforcement furnished by these bent bars, ½ in. sq. U-shaped stirrups are spaced as shown in elevation of beam, Fig. 2. In top flange of beam directly over stem are placed two ¾ in. sq. bars for full length of beam and two ½ in. sq. bars are also placed longitudinally near edge of flange in top. To give the flange strength at right angles to stem, ½ in. sq. bars 3 ft. 8 in. long are placed in top of flange at 8 in. centers, and 3 in. fillets are placed at junction of slab and stem. Handling hooks, ¾ in. bars of medium steel, are embedded in the beams at about 11 ft. from each end. Each beam contains 7.67 cu. yds of concrete which would make their weight about 15 tons.

The trussed handrails are 5 ft. 4 in. high at center with the top rail sloping ¾ in. per ft. to the ends where the height is 4 ft. 1⅛ in. The bottom chord is 12 in. wide and 1 ft. 5 in. deep reinforced with three 1 in. sq. bars, while the top chord is the same width and 9 in. deep, reinforced with three ¾ in. sq. bars in top. The space between chords is divided up into ten panels with 45 degree diagonals 6 in. wide and 7 in. deep reinforced with two ½ in. sq. bars bent around the chord reinforcing. (See Fig. 2.) At the ends of trusses for a length of 2 ft. 6 in. is a solid block of concrete 1 ft. wide and 5 ft. 1 in. deep to form the end bearing. To handle these trusses lifting hooks were placed at the second panel point from center, looped under top chord. These railings weigh about 10 tons each.

The bearing blocks are a little over 1 ft. thick and 2 ft. 6 in. wide reinforced longitudinally with four ½ in. sq. bars in top and bottom and ½ in. bars 2 ft. centers transverse in both planes. At the ends the blocks are carried up to a height of about 4 ft. 4 in. to form a lateral support for railings which are grouted in at the ends. (See Fig. 2.) The bearing blocks weigh about 5.5 tons each and are provided with handling hooks for erection.

That these bridges can be quickly erected is proven by the fact that about three hours is required to remove old structure and erect the new, under ordinary conditions.

Details of Design—Type B.

The *Type B* bridge is a six-unit flat slab structure three units wide spanning two tracks with a double post bent at center between tracks. The clear roadway is 12 ft. wide with a curbing 1 ft. wide and 1 ft. high at each side cast integral with outside slab units and surmounted by a gas-pipe handrail. (See Fig. 3.)

The slabs at abutments rest on reinforced concrete bearing blocks 3 ft. wide grouted to the old abutment masonry. These blocks weighing 6 tons each are provided with two handling hooks.

The two-post bent between abutments is also of unit construction except for the reinforced concrete footing beam 1 ft. 4 in. thick, 3 ft. 6 in. wide and 13 ft. 10 in. long, with 3 ft. 6 in. sq. pedestals 3 ft. 2 in. high, at each end, upon which the 20 in. sq. posts rest. (See Fig. 4.) The posts reinforced with four ¾ in. sq. vertical bars, tied together with ½ in. sq. ties, 18 in. centers, are 21 ft. high and are set in recesses 6 in. deep in both footing and cap beam. The weight of columns is 4 tons each. The cap beam 2 ft. 2 in. wide and deep and 15 ft. long is reinforced with seven ¾ in. sq. bars in bottom bent up over tops of columns and four ¾ in. bars in top with four ½ in. stirrups at 6 in. spacing at columns. This cap is provided with one lifting hook and has a weight of 5 tons.

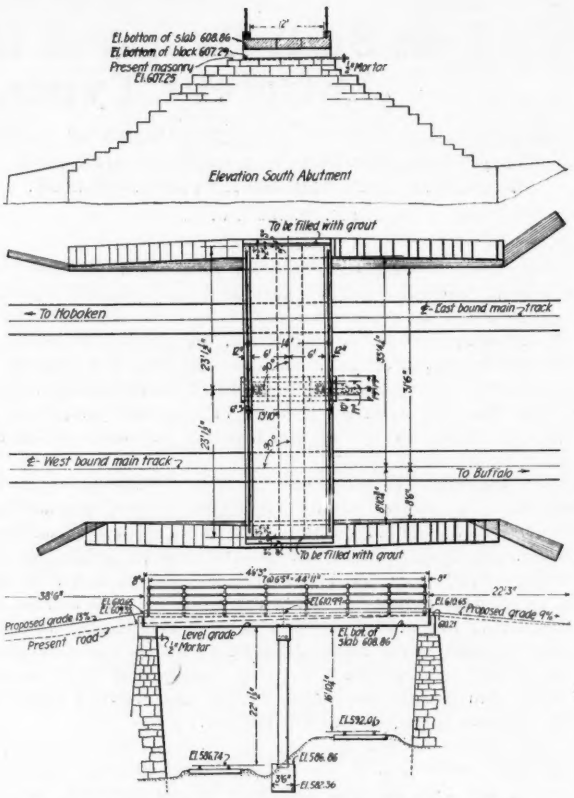


Fig. 3. Type B. Concrete Overhead Highway Bridge. D. L. & W. R. R.

The roadway slabs, six in number, have an overall length of 23 ft. 1½ in. and are 1 ft. 4 in. thick. The two middle slabs 4 ft. wide, are reinforced with ten ¾ in. sq. bars in bottom longitudinally at 4½ in. spacing, six being straight, and four being bent up to top of slab at each end, 2 ft. 6 in. from edge of support. The top reinforcement consists of four ¾ in. sq bars. The transverse reinforcing is of ¾ in. bars 2 ft. centers top and bottom. (See Fig. 4.)

The outside slabs are 5 ft. wide with a 1 ft. x 1 ft. curb at the edge. The reinforcement of these slabs is the same as the middle slabs except that two additional ¾ in. sq. bars are placed in top and bottom of curb. The 3 in. posts of gas pipe handrail are set in pockets left in curb at time of pouring. At the top edges where slabs adjoin a notch 2 in. deep is provided for waterproofing the joint. Handling hooks are provided at each end of slab, a detail of these hooks being shown in Fig. 4. The middle slabs weigh 10.5 tons each and the outside units weigh 14.75 tons each.

Cost Data.

Four bridges of *Type A* and one of *Type B* have been built at a total cost of $3,700 or $740 each, if it is assumed that each type will cost about the same. This reduced to a square foot basis for overall dimensions, makes the cost about $1.32 per

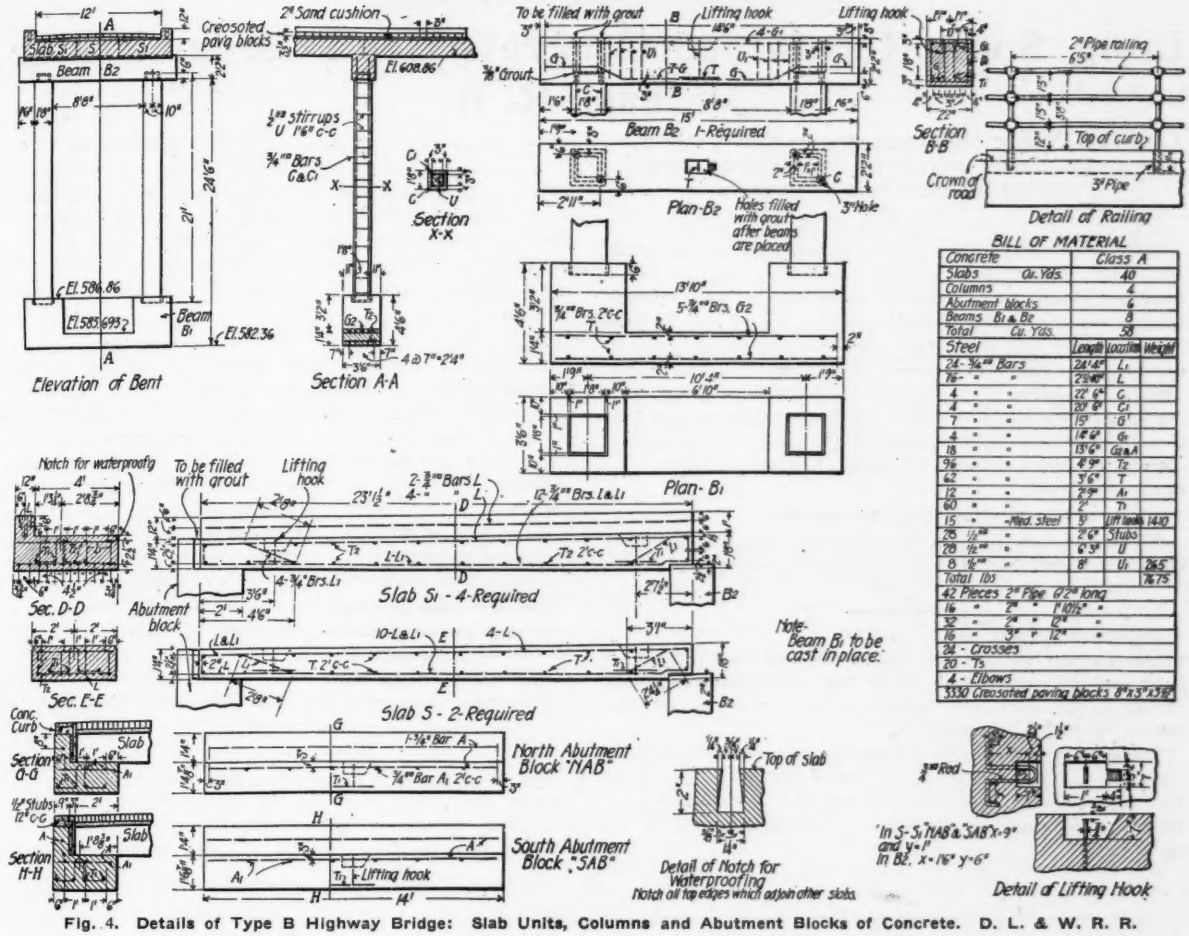

Elevation of Bent
Section A-A
Section X-X
Plan-B2
Plan-B1
Slab S1 - 4-Required
Slab S - 2-Required
Sec. D-D
Sec. E-E
Section G-G
Section H-H
North Abutment Block "NAB"
South Abutment Block "SAB"
Detail of Notch for Waterproofing
Notch all top edges which adjoin other slabs.
Detail of Lifting Hook
Detail of Railing
Section B-B
Note. Beam B1 to be cast in place.
BILL OF MATERIAL
Concrete Class A
Slabs Cu. Yds. 40
Columns 4
Abutment blocks 6
Beams B1 & B2 8
Total Cu. Yds. 58
Steel
24 - 3/4" Bars 24' 4" L1
76 " " 23' 4" L
4 " " 22' 6" C2
4 " " 20' 8" C1
7 " " 15' G'
4 " " 16' 6" G2
18 " " 13' 6" G2 & A
96 " " 4' 9" T2
42 " " 3' 6" T
12 " " 2' 9" A1
60 " " 2" T1
15 " Med. Steel 5' Lift hooks 1410
28 1/2" " 2' 6" Stubs
28 1/2" " 6' 3" U
8 1/2" " 8' U1 265
Total lbs 7675
42 Pieces 2" Pipe 12' 2" long.
16 " 2" " 1' 10 1/2" "
32 " 2" " 2' 4" "
16 " 3" " 12" "
24 - Crosses
20 - Ts
4 - Elbows
3330 Creosoted paving blocks 8" x 3" x 3 1/2"

Fig. 4. Details of Type B Highway Bridge: Slab Units, Columns and Abutment Blocks of Concrete. D. L. & W. R. R.

sq. ft. which is a low price for such bridges. It should be borne in mind, however, that the cost of abutments does not enter into this calculation since the old existing masonry was used in each case.

Comment.

In view of the great fire hazard to which wooden overhead highway bridges are subjected by the direct blast from locomotives, a fireproof bridge is particularly desirable for such locations and will in the end prove the cheaper. The maintenance expense for a concrete structure is nothing, the structure is fireproof and if built in convenient units is easily erected at a comparatively low cost as shown by the example herein given.

The writer is indebted to Mr. G. J. Ray, chief engineer, and Mr. A. B. Cohen, concrete engineer, D. L. & W. R. R., for plans and data used in this article.

MODEL GRADE CROSSING OF CONCRETE.

Coroner Peter Hoffman of Cook County, Ill., has been doing a great work in the abolition of dangerous grade crossings. His report for the first six months of 1914 show that the crossing death roll was 52 per cent lower than eight years ago. In this time the population has increased 25 per cent.

In 1906, 100 people lost their lives at grade crossings, while for the first half of 1914 with three times as many crossings and ten times as many trains operating over them, and four times as many people using these crossings only 24 people lost their lives. Mr. Hoffman explains this decrease in grade crossing mortality, as the result of building grade crossings which give a man a chance for his life.

Coroner Hoffman argues that 50 per cent of the crossing accidents are directly due to the "rough crossing." For this reason he has had installed at Desplaines a smooth concrete crossing of his own design for that purpose.

Mr. Hoffman states that in starting an automobile or wagon over a rough crossing the danger is doubled or trebled.

"In the first place the driver is forced to slow down, almost to a walk in the case of some crossings I have known. In the case of a motorist it means that he must throw his machine into slow speed and drift onto the crossing or break a spring.

"Then he finds himself on the track in front of a plunging train. Immediately there is confusion aboard the automobile. Usually the driver becomes panic-stricken. He 'shoots the gas' into his engine and kills it. Then comes the inevitable.

"That is the story of practically all the coroner's cases in which automobiles have been struck by trains. With the smooth grade crossing that machine and every one like it would never be struck by a train. And on that account we are trying for the concrete crossing."

The officials of the Chicago & Northwestern Railroad and the Chicago, Milwaukee & St. Paul Railway are co-operating with Coroner Hoffman in this experiment.

The crossing consists of a number of unit blocks of concrete weighing about 350 each resting on steel supports on the ties between rails. These blocks fit closely together but can readily be removed to allow ballasting and surfacing of track which cannot be done with a solid concrete crossing.

The concrete crossing on account of its durability should lower considerably the cost of crossing maintenance and if the Desplaines test crossing proves satisfactory the days of the wooden crossing are numbered. In this connection Mr. Hoffman is to be most heartily commended in his *Safety First Campaign for Grade Crossings*, and it is indeed encouraging to see the railroads co-operating with him.

Long Span Reinforced Concrete Deck Girder Bridge, Wabash R. R.

A SINGLE TRACK CONCRETE STRUCTURE WITH BALLASTED FLOOR SUPPORTED ON PAIRS OF DEEP GIRDERS THIRTY-TWO FEET LONG.

By A. M. Wolf, C. E.

Reinforced concrete deck girder bridges for railroad traffic are rather unusual and for this reason the structure herein described, should be of special interest to bridge engineers. This single track bridge located on the Wabash R. R. near Wilcox, Mo., is 161 ft. long and 14 ft. wide over all, made up of five deck girder spans resting on piers 32 ft. 3 in. centers. Each span consists of two girders 1 ft. 6 in. wide by 6 ft. deep under deck slab which is 12 in. thick, with a parapet 1 ft. 6 in. high at each side to retain the ballast. The girders are spaced 8 ft. centers and are tied together by cross struts 1 ft. wide at center and ends.

Loadings and Unit Stresses.

The bridge was designed for Cooper's E-50 live load with impact as ascertained by the following formula:

$$I = \frac{L^2}{L + D}$$

where L equals the live load and D the dead load. The dead loads used were as follows: Rails, ties and fastenings assumed at 200 lb. per lineal foot; ballast at 100 lb. per cubic ft., and concrete at 150 lb. per cubic ft.

The unit stresses used were those specified by the Amer. Ry. Eng. Assoc., viz.: Tensile stress in steel 17,500 lb. per sq. in. for high carbon corrugated bars; compression (cross-bending) in concrete, 750 lb. per sq. in.; shear in plain concrete 40 lb. per sq. in.

The girders were designed and built as simple beams with a 3 in. expansion joint between ends of girders. At the ends of girders bent-up bars and stirrups provide for the shearing stresses in excess of 40 lb. per sq. in. and in such case one-third of shear was assumed as taken by the concrete. Since the floor slab cantilevers out over the girders a distance of 2 ft. 3 in., bent and straight bars are provided in top of slab to care for the cantilever action.

Details of Design.

Piers—The intermediate piers, four in number, are of plain concrete resting on a reinforced concrete footing carried on wooden piles. (Fig. 1.) The piers have a top width of 3 ft. 6 in., and a length of 13 ft. 6 in. under coping which projects 3 in. with a side and end batter of ½ in. to the ft. The ends are made semi-circular to the top of footings which are 19 ft. long by 12 ft. wide with a depth of 5 ft. at neat line sloping down to 3 ft. at the edge. The reinforcing over piles consists of 1 in. diameter bars 4 in. centers transversely and four 1 in. dia. bars 12 in. centers each side of the center.

The approaches at either end of the bridge being pile trestles (see Fig. 1), no abutments are required and the girders are carried on a narrow plain concrete pier with stepped footings without piling. These piers are 2 ft. 6 in. thick and 14 ft. long at top with a ½ in. batter on sides. The ends of girders are carried 9 in. beyond the center line of pier so as to make the load more central in its application.

The center piers are 26 ft. 6 in. high above footing, the intermediate piers, 23 ft. 6 in. and the end ones 12 ft., the base of rail being 24 ft above high water level in the creek.

Superstructure—The girders 18 in. wide and 7 ft. deep are

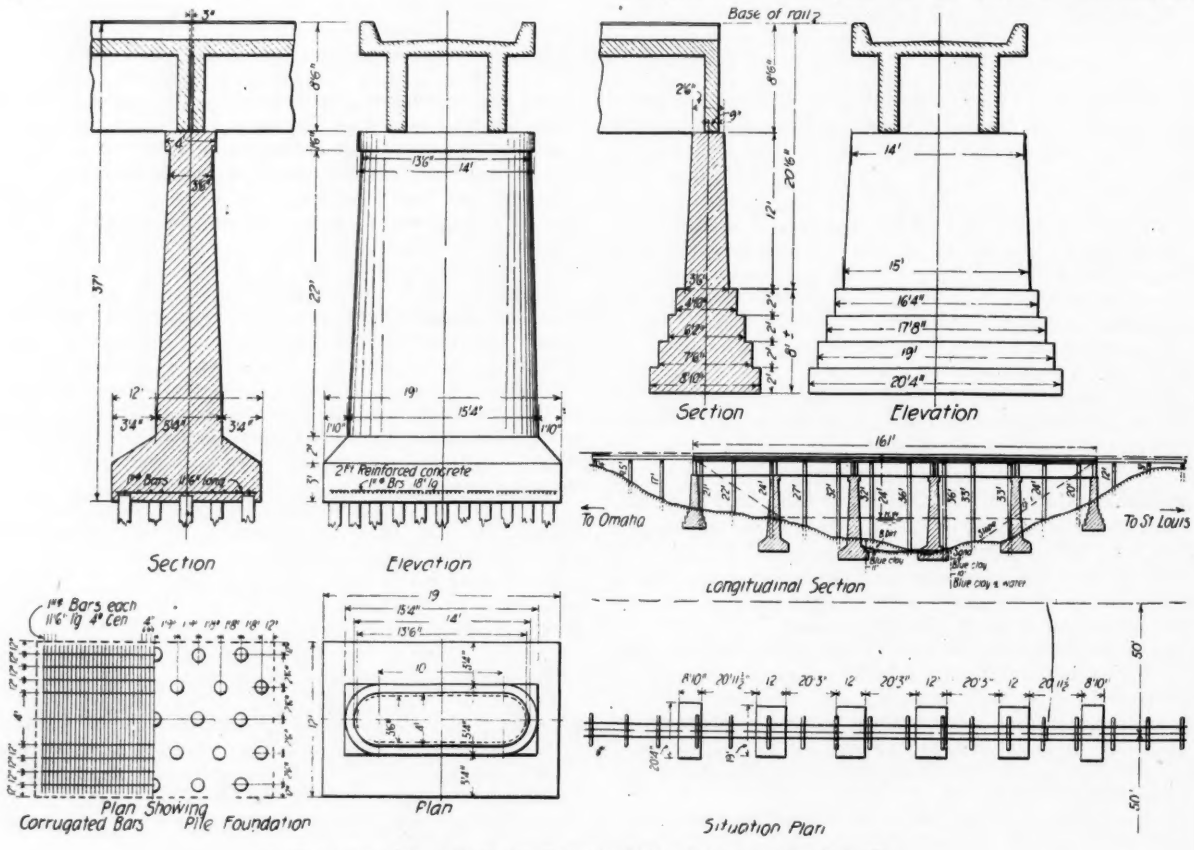


Fig. 1. Details of Piers for Concrete Girder Bridge. Wabash R. R.

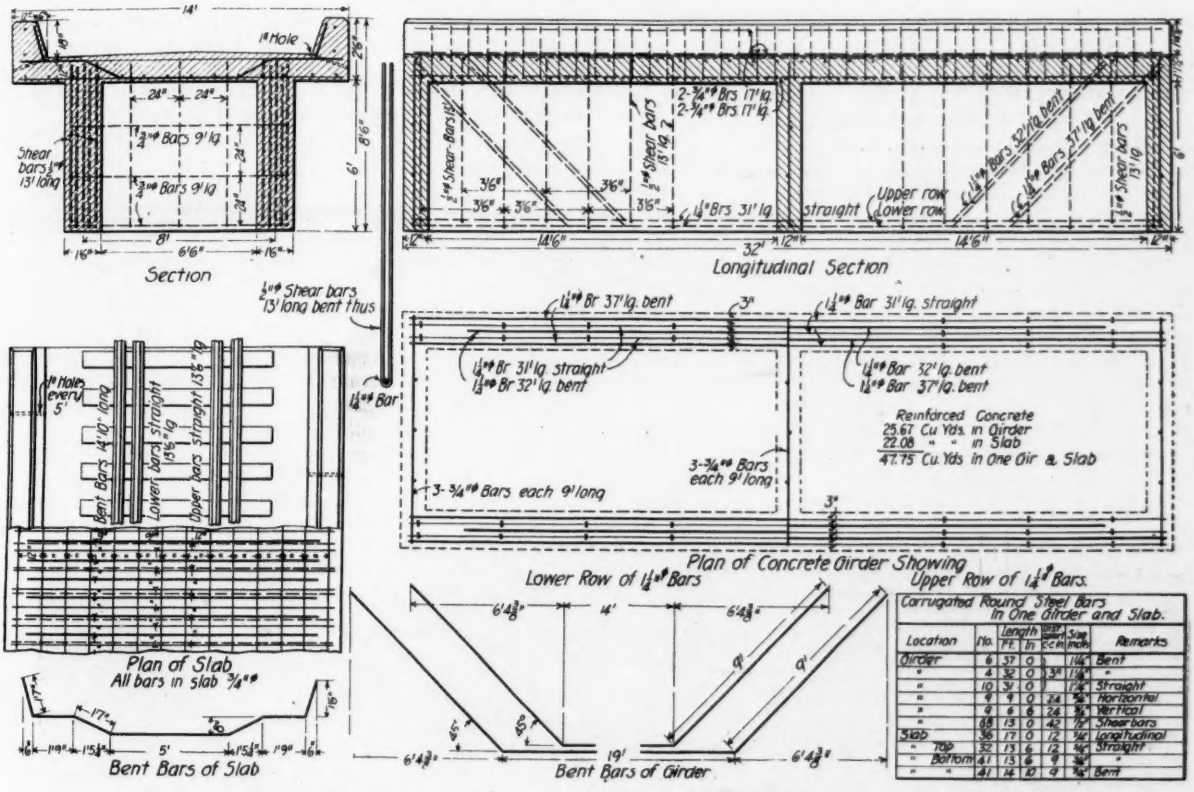

Section
Longitudinal Section
Plan of Concrete Girder Showing
Plan of Slab
All bars in slab ¾"ø
Bent Bars of Slab
Bent Bars of Girder
Lower Row of 1¼"ø Bars
Upper Row of 1¼"ø Bars.
Reinforced Concrete
25.67 Cu Yds. in Girder
22.08 " " in Slab
47.75 Cu Yds in One Gir & Slab
Corrugated Round Steel Bars In One Girder and Slab.
Location | No. | Length Ft. | Length In | Weight Each Pc. lbs | Size inch | Remarks
Girder | 6 | 37 | 0 | | 1¼ | Bent
" | 4 | 32 | 0 | 33 | 1¼ | "
" | 10 | 31 | 0 | | 1¼ | Straight
" | 9 | 9 | 0 | 24 | ⅝ | Horizontal
" | 9 | 6 | 6 | 26 | ⅝ | Vertical
" | 68 | 13 | 0 | 49 | ¾ | Shear bars
Slab | 36 | 17 | 0 | 72 | ¾ | Longitudinal
" Top | 32 | 13 | 6 | 72 | ¾ | Straight
" Bottom | 41 | 13 | 6 | 9 | ¾ | "
" " | 41 | 14 | 10 | 9 | ¾ | Bent

Fig. 2. Details of 32-ft. Reinforced Concrete Deck Girders and Slab. Wabash R. R.

reinforced with ten 1¼ in. dia. bars arranged in two rows at 3 in. centers, five bars being bent at the ends at 45 degrees as shown in Fig. 2 while the others are straight. The bent bars are bent up to aid in caring for shearing stresses at either side of the point of span where they are no longer required for resisting the bending moments. Additional shear reinforcement is provided in the shape of ½ in. dia. "hairpin" rods looped around the reinforcing bars which are straight. (See Fig. 2.) These shear bars are spaced in groups at 1 ft. 9 in. centers, staggered so as to have two around the bars in bottom row and then three around those in top row. Seven such groups of stirrups are placed at each end.

At the ends and middle the girders are tied together with a 12 in. cross strut for the full depth. These struts are reinforced at center with ¾ in. dia. bars 2 ft. centers horizontal and vertical.

The floor slab is 12 in. thick at the parapets and 1 ft. 1½ in. at the center to provide for drainage to the 1 in. drain holes placed through slab at sides at 5 ft. intervals. The transverse or main slab reinforcement (see Fig. 2) consists of ¾ in. dia. bars alternating bent and straight at 4½ in. centers. The bent bars bend up into top of slab over girders and the ends are then bent up parallel with inside face of parapet. Additional transverse reinforcement is provided in the top by ¾ in. straight bars at 1 ft. centers. Longitudinal reinforcement, ¾ in. bars at 12 in. centers, is placed in bottom of slab directly over main bars. Two ¾ in. bars are also placed continuous in middle of parapet which is 18 in. high 1 ft. 6 in. thick at base and 12 in. at the top, the outside face being kept vertical. The top edges are given a 1½ in. chamfer.

Quantities of Materials.

For this structure 418 cubic yards of plain concrete was used in piers, 67 cu. yds. of reinforced concrete in pier footings, and 239 cubic yards of reinforced concrete in girders and slabs. A total of 17.25 tons of steel was required for superstructure and 4.25 tons for footings. The plain concrete was of a 1:3:5 mixture, while in the reinforced work a 1:2:4 mixture was used.

Comment.

The writer is indebted to Mr. A. O. Cunningham, chief engineer of the Wabash Railroad, for plans and data used in making up this article.

GRADE SEPARATION WORK. MILWAUKEE, WIS.

The grade separation project of the Chicago, Milwaukee & St. Paul for the northwestern part of Milwaukee, Wis., has been brought one step nearer the construction stage. The State Railroad Commission issued an order for track depression and directed that the work must be started before July 1, 1916, and must be finished by Dec. 13, 1918. The order calls for the separation of street grades between Thirty-eighth street and Fond du Lac avenue. With one exception the streets crossing the track will either be closed or be above the tracks. The exception to this plan will be at Clark street, where a subway for pedestrians will be built.

The following are the crossing changes to be carried out: Thirty-fifth street, bridge above the railroad tracks; no approach on McKinley boulevard; Vliet street, bridge crossing, 7 feet above present grade; Thirty-fourth street, side approach 4½ ft. above present grade; Thirty-third street, bridge over tracks 7 ft. above present grade; Galena St. bridge 1 ft. above present grade; Lisbon avenue, Brown street and North avenue, overhead crossings at present grade; Clark street, cut 10 ft. for subway; Center street, crossing at a cut of 9½ ft.

The cost of the improvement is estimated at about $3,000,000, apportioned as follows: 70 per cent to the Chicago, Milwaukee & St. Paul; 25 per cent to the city of Milwaukee, and 5 per cent to the Milwaukee Electric Ry. & Light Co.

"CONCRETE FOR PERMANENCE."

NOVEL ARCHITECTURAL TREATMENT OF AN OVERHEAD HIGHWAY BRIDGE.

COLORED TILE USED TO EXCELLENT ADVANTAGE IN THE DECORATION OF PARAPETS OF THE 66th AVE. ARCH BRIDGE, PHILADELPHIA.

By A. M. Wolf, C. E.

The 66th Avenue Arch Bridge over the North Pennsylvania R. R. tracks, Philadelphia, Pa., which although it follows the same general lines of other structures of the same type built by the city, is a distinct departure therefrom as far as the architectural treatment of the inside face of handrails is concerned. On account of being located in a fine residence district it was decided that the parapets should have an unusual treatment to make the street crossing attractive instead of unsightly. For this purpose dull-glazed Grueby tile of different colors arranged in simple designs were placed in flush panels on the inside face of handrail as shown in Figure 1. Another feature of the design is the buttressed abutments, which effected a considerable saving in cost with added stability to the bridge.

The structure with a clear span of 40 feet on a 15 degree skew is 80 ft. wide, 50 ft. being for roadway which is flanked by two 15 ft. sidewalks. The span at face is 41 ft. 6¼ in. on account of skew and the extrados of arch is an ellipse with a rise of 8 ft. 10⅝ in. which allows a 16 ft. clearance over the outer rails of the double track railroad line. (See Fig. 2 and 3.)

The arch ring is of plain concrete 2 ft. thick at the crown and is designed to carry in addition to the dead load a live load consisting of a 40-ton truck on any part of the roadway and 100 lb. per sq. ft. of sidewalk with a maximum compressive stress in concrete of 500 lb. per sq. in. The concrete used was of a 1:2½:5 mixture with about 30 to 40 per cent of one-man stone embedded in the arch ring normal to lines of pressure.

The arch ring is carried on abutments consisting of six plain concrete buttresses 7 ft. wide and 20 ft. 5 in. long with sloping back, the base, resting on micaceous gneiss, being cut back perpendicular to lines of pressure. These buttresses spaced 7 ft. 2 in. apart are of 1:3:6 concrete and are connected by a face wall 3 ft. thick reinforced with ¾ in. sq. bars vertical at 2 ft. 8 in. centers in middle of wall and four ⅞ in. sq. bars horizontal near skewback.

The outer buttresses form the wing walls and are separated from the spandrel wall and arch ring, at the face, by an asbestos lined expansion joint concealed by the reveal of pilasters formed at each side of the span. Similar pilasters at the ends of wings preserve the balance of the structure (see Fig. 2).

The spandrel walls are of a gravity section poured after the arch centers were struck and have a light temperature reinforcement placed longitudinally in top to guard against cracks which might be occasioned by any movement of arch ring or spandrels. At the top of the spandrels at the level of the sidewalks is a heavy molded coping of neat design surmounted by the ornamental handrail mentioned above. The handrail, 8 in. thick, is paneled on both sides, the outside having sunken panels with scrubbed concrete finish; while the inside panels are of tile set flush with the face. The predominating color of tile used is a terra cotta red with enough dark green and blue to emphasize and give character to the design. The use of various sized tile also aided materially in obtaining the desired results. The concrete on outside face of spandrels, wings and handrails and also on inside of latter around tile panels is of a rough texture with clearly defined and sharp corners obtained by using a facing mixture of ¾ inch crusher run stone and scrubbing the surface the day after pouring.

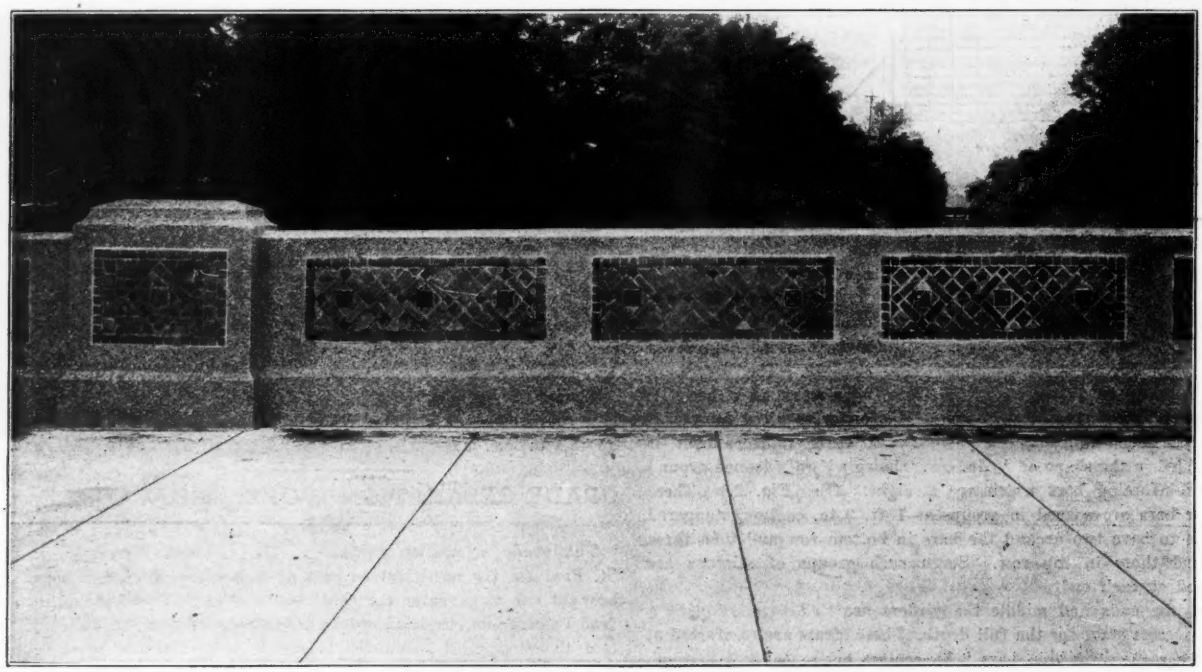


Fig. 1. Portion of Parapet Wall, 66th Avenue Bridge, Philadelphia, Pa. Showing Detail of Ornamental Tile Decoration.

Construction Details.

Owing to its location the bridge had to be built in such a manner as to not obstruct traffic at any time on the tracks below. This was accomplished as shown in Figure 3 by the use of cantilever steel trusses to hold up the lagging for arch ring which was poured in six longitudinal sections, each about 14 ft. wide. The trusses consisted of a cantilever arm at each side supported on a timber bent as close to track as possible and anchored down at the springing line, with a shallow lattice truss suspended between, over the track.

After the arch ring was completed and centers struck the spandrel walls were poured up to the level of the sidewalk. The handrails over abutment wings were then poured and lastly the portion over the arch. The spandrels have the plain surface relieved by horizontal coursing joints in addition to the scrubbed surface.

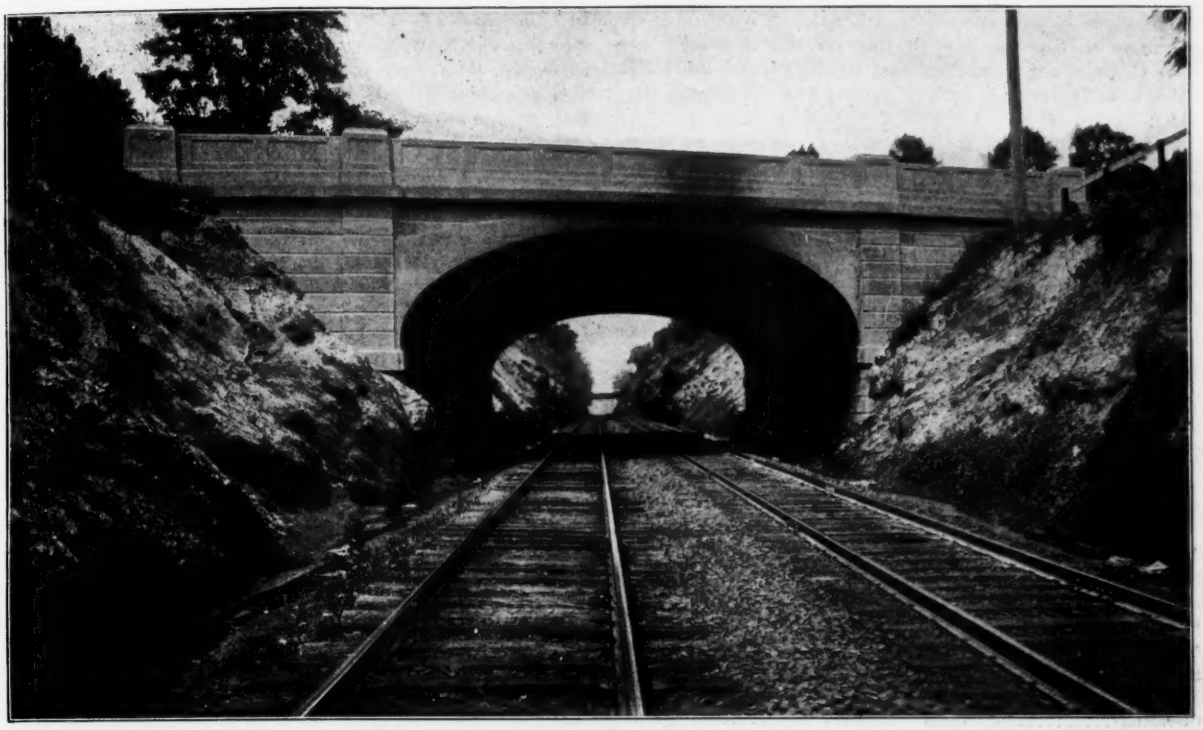


Fig. 2. 66th Avenue Concrete Arch Bridge, Philadelphia, Pa.

On the inside face of handrail 3 in. recesses were boxed in the concrete wherever tile panels were to be placed. The last concrete having been placed in late fall the boxes were left in place over winter and the tile set in the spring. To aid in holding the tile backing in these recesses ¼ in. rods were embedded in the parapet so as to project into the recesses and when the cement mortar backing for tile was placed these stub bars were laced in various directions and the backing put in for a depth of 2 inches and the tile set in place, thus securely anchoring the tile work to the parapet. The tile work was finished by pointing with neat cement and scrubbing with weak acid to remove cement stains, then washed to remove acid and coated with linseed oil.

That the method of decoration used is attractive and indeed something out of the ordinary in the architectural treatment of bridges is shown by Figure 1 which gives a close view of the parapet. Tile inserts have been used in other cases to decorate bridge spandrels and parapets but they have not been entirely successful because the tile work did not cover the entire recess left in concrete to receive it and also because enough attention was not paid to the obtaining of a piece of work as nearly integral as possible.

Fig. 3. Construction View. Showing Arch Centering Used Over Track.

The bridge was designed and construction supervised by the Bureau of Surveys, Department of Public Works, Mr. G. S. Webster, chief engineer and Mr. Jonathan Jones, ass't engineer, to whom the writer is indebted for plans, photographs and data used in making up this article.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—The prices of cement market are almost uniformly a trifle lower than those quoted last month, except in certain localities, and the demand is about the same. Prices given f. o. b. cars at points named, including cloth sacks, for which, in general, 40c per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, $1.72; New York, $1.58; Chicago, $1.55; Pittsburgh, $1.45; New Orleans, $1.64 on dock; Memphis, $1.64; Cleveland, $1.68; Detroit, $1.54; Indianapolis, $1.58; Columbus, $1.67; Toledo, $1.53; St. Louis, $1.45; Milwaukee, $1.50; Minneapolis and St. Paul, $1.60; Kansas City, $1.43; Omaha, $1.43; Spokane, $1.75; Seattle, $2.30; Tacoma, $2.30; Portland, Ore., $2.30; Duluth, $1.73.

Crushed Stone—1½-inch stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 90c to $1.00, in full cargo lots at the docks; Chicago, $1.15; Spokane, $1.00; Portland, Ore., $1.15; Seattle, $1.50.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 90c in full cargo lots at docks; Chicago, $1.15; Spokane, $10.00; Portland, Ore., 85c; Seattle, 75c; Tacoma, 75c.

Sand—Prices are per cubic yard f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, $1.15; Spokane, 75c; Seattle, 75c; Portland, Ore., 85c; Tacoma, 75c.

Reinforcing Bars—Prices in general are somewhat lower than those quoted last month. Pittsburgh base quotations on mill

shipments f. o. b. cars are from $1.15 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs. for mill shipments from other points, f. o. b. cars: New York, $1.76; Philadelphia, $1.75; Chicago, $1.78; Spokane, $2.20; Seattle, $1.85; Portland, Ore., $1.90; Tacoma, $1.85.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, $1.60; New York, $1.85; Cleveland, $1.80; St. Louis, $1.80; Chicago, $1.65; Spokane, $2.50; Tacoma, $2.20; Portland, Ore., $2.15; Seattle, $2.20.

Metal Clips for Supporting Bars—$4.50 to $6.50 per 1,000, depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Sandusky Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipments are in general sold on a Pittsburgh basis; this is, at the Pittsburgh quotations plus the freight to the point in question, and with the following list of freight rates on finished material and the Pitsburgh quotation given, the prices of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Columbus	12 cents
New York	16 cents	Cincinnati	15 cents
Philadelphia	15 cents	Louisville	18 cents
Baltimore	14½ cents	Chicago	18 cents
Boston	18 cents	Richmond	20 cents
Buffalo	11 cents	Denver	84½ cents
Norfolk	20 cents	St. Louis	22½ cents
Cleveland	10 cents	New Orleans	30 cents
Minneapolis	32 cents	Indianapolis	17 cents
Kansas City	42½ cents	Omaha	42½ cents
Birmingham	45 cents		

New Books

STRUCTURAL ENGINEERS' HANDBOOK.—Data for the Design and Construction of Steel Bridges and Buildings. By Milo S. Ketchum, C. E. Leather, 6½x9 in., 916 pages, 400 illustrations. Published by McGraw-Hill Book Co., New York. Price $5.00 net.

In this book one will find the "meat" of four previous books by the author, on "Mill Buildings; Highway Bridges; Walls, Bins and Grain Elevators; and Mine Structures," with considerable new material of a valuable character, so arranged as to make it the best handbook on the subject of structural engineering which has been published. As the title implies the book is purely a reference work, no elementary matter on applied mechanics or calculation of stresses being given, the main idea being to furnish data and details that are available only to a few engineers and standard specifications for materials and workmanship that are available only in transactions of societies and in special treatises, thus making the book a source and not a treatise.

As the book is intended to supplement the present books on stresses the calculation of stresses in bridges and buildings has only briefly been considered. The calculation of stresses in retaining walls, bins, standpipes and other structures not ordinarily covered in textbooks are given in compact form. Swing and movable bridges, cantilever and suspension bridges requiring special treatment have not been considered.

The book is divided into two self-contained parts, the first, dealing with the design of structures, gives data and details for the design of steel bridges and buildings; while Part II contains such tables for structural design as properties of rolled sections, built-up sections for chords, columns, struts, plate girders and data for standard structural details. The 165 tables in this part cover 280 pages and form a very complete set, including practically all a designer needs except such as are readily accessible, viz.: logarithms, functions of angles and similar tables. In this connection, however, the reviewer doubts the need of including such tables as are found in the Carnegie and Cambria handbooks which every designer invariably keeps within reach. The space gained by the omission of these tables could have been used to better advantage as cited further on in this review.

Referring again to Part I we find the following subjects treated: Steel Roof Trusses and Mill Buildings, Steel Office Buildings, Steel Highway and Railway Bridges, Retaining Walls, Bridge Abutments and Piers, Timber Bridges and Trestles, Steel Bins and Grain Elevators, Steel Head Frames and Coal Tipples, Steel Standpipes and Elevated Tanks and Towers, Structural Drafting, Estimates and Erection of Structural Steel, Engineering Materials, Structural Mechanics and the Design of Steel Details.

In the chapter on Office Buildings no method of designing column bases is given and only the typical square castings, American Bridge Co. standard, are given, although it has been found by many designers that round castings are more economical, distribute loads more uniformly and are not subject to the unequal cooling stresses set up in the square bases which result in many cracked pieces. Nothing is given regarding the design of tall steel stacks used for such buildings.

The addition of data on sizes and weights of motor trucks in the chapter on highway bridges is almost imperative on account of the increasing use of motor trucks for hauling materials of all kinds.

The chapter on bridge abutments and piers, although not treating of the latest type of the framed or trestle abutment, will be found very useful to the designer by virtue of the many good examples of different types. In view of the fact that very few timber bridges and trestles are now built the reviewer doubts whether the use of twenty pages for this matter was advisable since some material which is more important was omitted. No method of calculating anchor bolt stresses in standpipes or stacks is given.

The chapters on structural drafting, estimating and erection are especially valuable and interesting, the latter being presented in a new and novel manner. The chapter on structural mechanics is very complete and in presentation the formulae and diagrams for stresses in loaded beams being made from neatly lettered plates, thus avoiding the many chances of error in setting up such material in type. The reprinting of this chapter in pamphlet form for the use of students in technical schools would in the reviewer's opinion be an excellent proceeding, its popularity being a foregone conclusion. The final chapter on design of steel details is exceptionally good.

Taken as a whole the work is of excellent character containing a wealth of new material of practical value and references to authorities for further information on various subjects.

ANALYSIS OF A THREE-LEGGED STIFF FRAME. By N. M. Stineman, Assoc. W. S. E. Paper, 6x9 in.; 22 pages; 11 illustrations. Published by author, 4932 Winthrop Ave., Chicago. Price 25c postpaid.

A reprint of a paper presented to the Western Society of Engineers, Sept. 14, 1914, giving the analysis of a three-legged stiff frame stressed by a horizontal load, with the mathematical work involved in the derivation of formulae by principles of least work. This paper will be of interest to the designing engineer since it relates especially to the design of frame abutments such as were ably treated in the March, 1914, issue of *Railway Engineering* by Mr. A. W. Hoffmann.

THE DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, has issued Bulletin No. 77 on "The Electrical Furnace in Metallurgical Work." This bulletin is well illustrated and contains 189 pages of reading matter and tables. Seventeen and a quarter pages of "Selected Bibliography" that is descriptive of publications in electrothermal and electrolytic industries. One page description of "Publications on Metallurgy and Mineral Technology." Seven and a quarter pages are devoted to a complete index of subject matters contained in the bulletin.

AMERICAN CONCRETE INSTITUTE.

The Eleventh Annual Convention of the Institute will be held at the Auditorium Hotel, Chicago, February 9 to 12, 1915. The Convention will mark the completion of the tenth year of the existence of the Institute, and an especially interesting and profitable program has been arranged. The sessions will be at 10 A. M., 3 P. M., and 8 P. M.

TENTATIVE PROGRAM, 11TH ANNUAL CONVENTION.

TUESDAY, FEBRUARY 9, 1915.

10 o'clock A. M.

CONCRETE ROADS AND BRIDGES.

Opening Address of Welcome.

Review of Present Practice in Concrete Road Construction—Percy H. Wilson, Secretary Association of American Portland Cement Mfrs., Philadelphia, Pa.

The Experimental Concrete Road in Philadelphia—William H. Connell, Chief, Bureau of Highways, Philadelphia, Pa.

Reinforcing Narrow Concrete Roads—John Mueller, Civil Engineer, New Castle, Ind.

Report of Committee on Concrete Roads—A. N. Johnson, Chairman.

3:00 o'clock P. M.

Comparative Cost of Concrete Roads—Percy H. Wilson, Secretary Association of American Portland Cement Mfrs., Philadelphia, Pa.

Cost of Construction and Maintenance of Concrete Roads—H. J. Kuelling, County Highway Commissioner, Milwaukee, Wis.

The Construction of Integral Curbs—Charles E. Russell, City Engineer, Highland Park, Ill.

Organization and Methods of Constructing Concrete Roads—William Acheson, Division Engineer, New York State Highway Commission, Buffalo, N. Y.

8:00 o'clock P. M.

Test of a Reinforced Concrete Slab Bridge—E. B. McCormick, Mechanical Engineer, Office of Public Roads, Washington, D. C.

Standard Designs for Concrete Highway Bridges and Culverts—C. B. McCullough, Designing Engineer, Iowa State Highway Commission, Ames, Ia.

Report of Committee on Standard Specifications for Concrete Highway Bridges and Culverts—Willis Whited, Chairman.

WEDNESDAY, FEBRUARY 10, 1915.

10 o'clock A. M.

CONCRETE AND REINFORCED CONCRETE TESTS AND DESIGN.

Report of Committee on Concrete and Reinforced Concrete—A. E. Lindau, Chairman.

Report of Committee on Nomenclature—F. C. Wight, Chairman.

Report of Committee on Insurance—J. P. H. Perry, Chairman.

The Design of Wall Columns and Wall Beams—Sanford E. Thompson, Consulting Engineer, Newton Highlands, Mass.

A New-Old Theory for Reinforced Concrete in Bending—L. J. Mensch, Contracting Engineer, Chicago, Ill.

12:00 o'clock, Noon.

Close of Ballot Box.

3:00 o'clock P. M.

Reinforced Concrete Stands, Stadiums and Bowls—Charles W. Leavitt, Jr., Civil Engineer, New York, N. Y.

The Design of Concrete Bins for the Storage of Cement—Leonard Wesson, Assistant to President, Universal Portland Cement Company, Chicago, Ill.

Tests on Egg-Shape and Circular Reinforced Concrete Sewer Pipe—Albert Goldbeck, Engineer of Tests, Bureau of Surveys, Philadelphia, Pa.

8:00 o'clock P. M.

Annual Address of President.

A Critical Review of Current Practice in Reinforced Concrete as Embodied in Building Regulations and the Joint Committee Report—Edward Godfrey, Consulting Engineer, Pittsburgh, Pa.

Basis of Current Practice in Design of Reinforced Concrete Structures—C. A. P. Turner, Consulting Engineer, Minneapolis, Minn.

THURSDAY, FEBRUARY 11, 1915.

9:00 o'clock A. M.

Business Session.

Annual Report of Board of Directors.

Report of Tellers.

10 o'clock A. M.

CONCRETE IN ART AND ARCHITECTURE.

Report of Committee on Edison Fire—Case Gilbert, Chairman.

Concrete; A Medium of Esthetic Expression—Irving K. Pond, Architect, Chicago, Ill.

Report of Committee on Cement Products—C. K. Arp, Chairman.

Cement Tile—J. S. Freund, General Manager American Cement Tile Manufacturing Company, Pittsburgh, Pa.

3:00 o'clock P. M.

The Fireproof Home—R. P. Stoddard, Executive Secretary, Society Advocating Fire Elimination, Cleveland, Ohio.

Report of Committee on Treatment of Concrete Surfaces—L. C. Wason, Chairman.

A New and Simple Method for Securing Dustless Concrete Floors—P. M. Bruner, P. M. Bruner Granotoid Company, St. Louis, Mo.

Topical Discussion on the Dusting of Concrete Floors.

8:00 o'clock P. M.

Annual Banquet in celebration of Tenth Anniversary.

FRIDAY, FEBRUARY 12, 1915.

10 o'clock A. M.

PLANT MANAGEMENT AND COST.

Contractor's Equipment, Austin-Nichols Warehouse—T. A. Smith, General Superintendent, Turner Construction Company, New York, N. Y.

Mechanical Plant for Handling Concrete—Wm. P. Anderson, President Ferro Concrete Construction Company, Cincinnati, Ohio.

The Strength of Concrete Forms—Harrison B. Taft, Contracting Engineer, Seattle, Wash.

Concrete Forms for the Catskill Aqueduct—Alfred D. Flinn, Deputy Chief Engineer, New York Board of Water Supply, New York, N. Y.

3:00 o'clock P. M.

Design and Construction of the Massachusetts Institute of Technology Buildings—Sanford E. Thompson, Consulting Engineer, Newton Highlands, Mass.

Report of Committee on Methods of Tests and Standard Specifications for Concrete Materials—Sanford E. Thompson, Chairman.

Placing Concrete with High Pressure Steam—Harold P. Brown, New York, N. Y.

Some Further Properties of Portland Cement Having a High Percentage of Magnesia—P. H. Bates, Chemist, Bureau of Standards, Pittsburgh, Pa.

PATENT CASE DECISION. TIE PLATES.

Federal Judge Baker in the United States Circuit Court of Appeals has made a decision giving the Railroad Supply Company the right to exclusive manufacture of railroad tie plates. Suits against several steel companies were started by the supply company in 1908, charging them with infringing on the patents which were issued in 1895. The United States District Courts in Cleveland and Chicago gave verdicts adverse to the supply company and the matter was appealed. "It is one of the most important decisions in patent cases ever made," said H. S. Hawley, president of the Railroad Supply Company. "It involved the basic patents on tie plates, and several million dollars was involved. For six years the case has dragged through the courts and some of the ablest lawyers of the country have acted as counsel."

A small railroad operating an oil-burning locomotive on the Tahoe National Forest, California, had a breakdown during the past summer and burned wood instead of oil for one day. On this day fifteen fires started along the right of way. During the preceding year, only one fire occurred near the railroad and it was not thought that the engine was responsible for that one.

The Engineer's Distress

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A.S. Gunn Editor

TO DEAR OLD "MAUD"

THERE ARE MANY DIFFERENT MODES
OF TRAVEL ON RAILROADS.
THERE'S THE LIMITED WHICH CROSS THE COUNTRY FLIES
THERE'S THE JERKY LOCAL FREIGHT
SOMETIMES EARLY — OFTEN LATE,
AND THE PLODDING HOBO FORCED TO WALK THE TIES.

THO' THE DAY COACH IS MUCH CHEAPER
SOME PREFER THE PULLMAN SLEEPER
IF THE JOURNEY IS TO TAKE THEM VERY FAR
BUT FOR MY PART I MUST SAY,
THAT I LOVE TO RIDE EACH DAY
ON MY MERRILY CHUGGING THREE-WHEEL MOTOR CAR.

WHEN I SHOVE HER DOWN THE TRACK
AND CLIMB UPON HER BACK
AS I LISTEN FOR THE REGULAR EXHAUST.
THE WORLD SEEMS FULL OF JOY
AND I CHUCKLE LIKE A BOY
PLAYING HOOKEY AND NOT THINKING OF THE COST.

DOWN THE HILLS WE SWIFTLY GLIDE
ROUND THE CURVES WE SAFELY RIDE,
TO ME THIS SEEMS THE POETRY OF MOTION.
BUT A FROG-POINT STANDING WIDE
TURNS "MAUD" OVER ON HER SIDE
AND WE STIR THE BALLAST UP IN GREAT COMMOTION.

SOON I GET HER STRAIGHTENED 'ROUND
AND THE SCATTERED TOOLS ARE FOUND
THEN A LITTLE "FIRST AID" RUBBED ON KNEE AND CHIN
HOW MY BRUISED AND ACHING BACK
STRAINS TO PUT "MAUD" ON THE TRACK;
SHE WEIGHS A TON AND I AM NEAR "ALL IN."

THEN I SHOVE AND GIVE HER JUICE
BUT ALAS! IT IS NO USE
THOSE SILENT CYLINDERS REFUSE TO BARK.
GASOLINE SHE HAS TO SPARE
AND COMPRESSION TOO IS THERE
BUT SHE SEEMS TO LACK THE NECESSARY SPARK.

NOW HER WIRING IS ALL NEW
AND HER BATTERIES ARE TOO.
SPARK PLUGS O.K.; LETS TAKE A LOOK BELOW.
AH! A BINDING POST IS LOOSE
JUST A TURN AND NOW THE JUICE
SHE'S WORKING ON BOTH SIDES! AWAY WE GO!

OH, I NEVER COUNT THE COST
AS WITH REGULAR EXHAUST
"MAUD" TAKES ME CHUGGING ON MY JOURNEYS FAR.
SHE'S MADE ME STIFF AND LAME
BUT I LOVE HER JUST THE SAME
MY ORNERY TREACHEROUS THREE-WHEEL MOTOR CAR.

A.S.GUNN.

Track Scales.

A. M. Van Auken, civil engineer.

In this discussion it is assumed the reader will consult the July, 1914, number of *Railway Engineering*, the paper by W. W. Boyd, read before the spring meeting of the A. S. M. E. at St. Paul, Minn., and the Track Scale Specifications and Rules of the A. R. A. It is the aim to discuss the most pertinent question before the users of track scales, "What is the Capacity of a Track Scale?"

To many the wording of the A. R. A. specifications as to capacity, are, to say the least, confusing. On page 4, under head 5, clause "c," one would assume, taking the reference to plate 16, that it was meant to assume a load of 65,000 lbs. to each main lever and primary knife edge. Taking then clause "i" under same head, it would be assumed that a primary knife edge 9½ inches in length would be ample. That this is sufficient for present-day service appears more than doubtful, and it is to be regretted that the association was not more clear in their wording of the clauses. As the capacity of the scale means to the average man the amount which may be weighed when loaded in the usual manner in a car, and which can be handled in the usual manner without injury or undue wear on the scale.

Since the issuance of the report, reviewed in *Engineering* last July, the maximum load permitted in the car then used as an illustration has been increased to 126,500 lbs., and with the weight of car added is as great as 170,500 lbs., giving a wheel load of 21,312½ lbs. Some say that we should adopt a wheel load of 25,000 lbs. when computing the stress on scales. For the present this paper will adopt 22,500 lbs. as a wheel load and the type of car shown in Fig. 9.

Weighing of cars is done in two ways, by spotting the cars on the scale and weighing while stationary, and allowing them to move slowly over the scale and securing the weight while in motion. The first is called "Spot Weighing" and the latter "Motion Weighing," and as about 90% of the cars are weighed by the spot method, this paper will discuss weighing from that standpoint.

At the present time the preference appears to be for a track scale with weigh rails 50 feet long, the scale about 51 ft. 2 ins. between bearings of end sections and a pit about fifty-five feet long. This type will be considered in the following.

The legitimate strains to which the mechanism of this scale is subjected in service are:

a. Actual weight imposed on the scale in the act of weighing. In this it is plain the load on any one section or pair of levers cannot exceed the load on one pair of trucks of the car being weighed.
b. The above load with a proper addition for impact. The latter being of two kinds:
   1. Inequalities of track and opening between track rails and approach rails.
   2. "Drag" due to stopping and starting the cars on the scale.
c. The load imposed upon the central sections of the scale by the trucks of two adjacent cars being in the position shown in Fig. 2 as one car is being placed on or pushed off the scale in spotting.

The question of the amount which should be added for impact is undetermined and from conditions appears not capable of accurate determination. Perhaps most men will agree on 100% of the weight which drops over the opening being added in case b 1, and 50% added in the case of b 2. "a" will be with the car being considered 90,000 lbs. "b" will add 50% to this, making it 135,000 lbs. per section. In each case the load on lever or knife edge will be one-half this. "c" as determined by Fig. 2 for this length of span will be 58,186 lbs. Adding to the last 50% for impact as in case of b 2 it will be 87,279 lbs. per lever. These various loads per lever are:

a. .....45,000 lbs.
b. 2.....67,500 lbs.
c. .....58,186 lbs.
c with an allowance for impact as b 2.....87,279 lbs.

But in addition to these necessary loads which accompany the working of track scales and are unavoidable in their operation, there are two abuses which, while deplorable, seem not wholly avoidable. These need not be provided against in the design of a scale as regards its being expected to weigh correctly to the specified amount, or even to bear it every day, but the scale should be designed so as not to be destroyed when subjected to them. These are:

a. The load resulting from the impact between a moving and dormant car while on the scale.
b. The passing of an engine over scale.

The former is due to the conditions shown in Fig. 9. As the point of contact between the cars is the coupler, which is below the centre of gravity of the cars, the difference depending on the type of car and material with which it is loaded, being smallest in case of a flat car loaded with material like steel rails, and perhaps highest in a furniture car loaded with hay or furniture, but it is always above the point of contact, and when the cars meet with any degree of force, the tendency is to lift the load from the trucks farthest from point of coupling and throw an increased load on the point nearest such point. It is not uncommon to see cars strike with such force that it appears to raise the car free from the trucks farthest from point of contact. It is not impossible that on frosty mornings, when tracks are slippery and there are several cars, which allow considerable "slack" between car on scales and engine, that this impact and the resultant action of the cars will add as much as 50% to the load on the scales. If then there be another 50% due to "drag," it is possible that in such cases of abuse the section may have a load of 116,500 lbs. thrust on each lever.

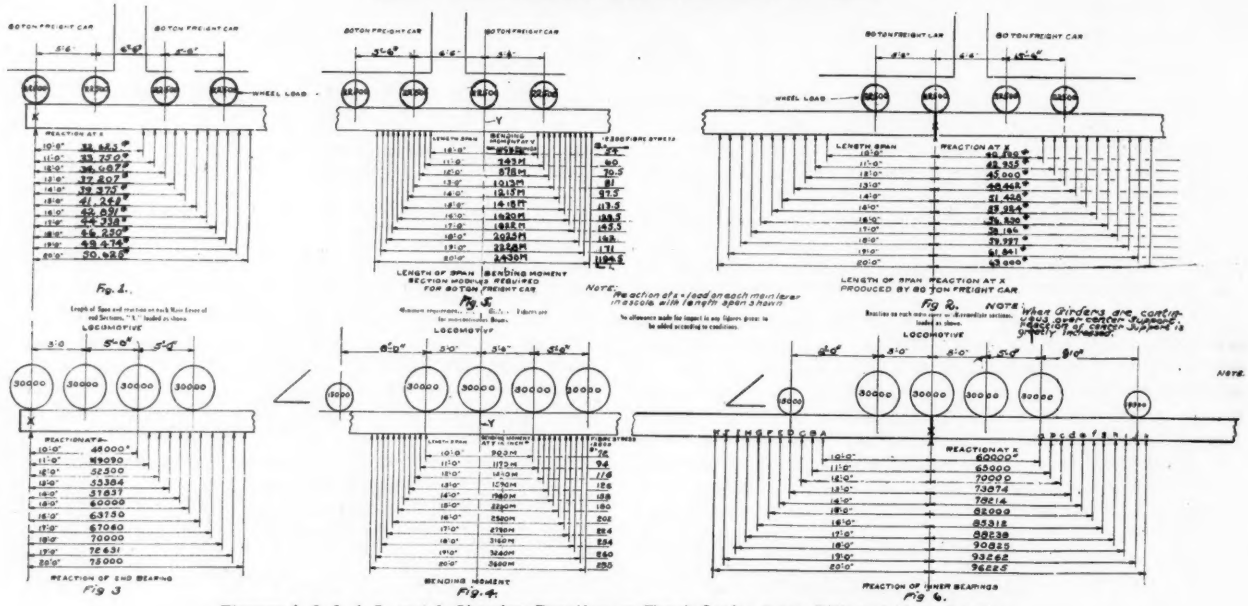
Abuse "b" will subject the sections to a load as shown in table 4, or for the scale we are considering 88,239 lbs. But this is also subject to an increase due to "drag," that is said by those who have investigated it to be as great as 50%, which would subject each lever to a load of 132,359 lbs. Thus the load per lever from abuse will be:

Abuse a.....116,500 lbs.
Abuse b.....132,359 lbs.

It is apparent that the scale need not be of such strength that there be no appreciable deflection of scale lever or weigh bridge under the latter loads. But it should be of such size that the levers and weigh bridge do not reach their elastic limit and assume a permanent set under even repeated abuses, and that the knife edges be not readily damaged by such abuse.

The rules for designing levers as given in the A. R. A. specifications may be followed. It would appear that they should be of a size that, under uses "a," "b" or "c," they will not deflect over one two-thousandth part their length, the weight to be applied and lever supported as when in service, and that under abuses "a" and "b" the same lever will not approach too close to its elastic limit. As the design of lever and material of which it is made will be determining factors in all calculations, nothing further will be said concerning them.

The permissible load on knife edge is to some extent in dispute. Bach (Germany) states that the load should not exceed 2,000 kilogrammes per centimetre in length, and it is better not to exceed 1,000 kilogrammes per centimetre of length, while Martens (Belgium) states that it is safe to load up to 4,000 kilogrammes per centimetre of length. These are both results determined from tests in a "Strength testing machine." In America a few tests have been made and the results have shown that failure occurred



Figures 1, 2, 3, 4, 5, and 6, Showing Reaction on Track Scales from Different Type Loads.

when from 16,000 lbs. to 20,000 lbs. per lineal inch had been applied. These have not been made with sufficient care to be entirely reliable. It is also probable that steel would fail under half the load in service in a scale which it would endure under the slow application of a testing machine. The loads used in practice are as follows:

Designer using or recommending.	Load per lin. in.
A. W. Epright, Penna. R. R. scale	4,000 lbs.
A. Bousfield, E. & T., Fairbanks & Co	5,000 lbs.
E. Motchman, Standard Scale & S. Co	5,000 lbs.
W. W. Boyd, paper before A. S. M. E.	5,000 lbs.
Amn. Ry. Assn., specifications (not to exceed)	7,000 lbs.
Bach (Germany) recommended	5,600 lbs.

Taking the A. R. A. "Not to exceed" and applying it to abuse "b" it will call for a knife edge nearly 19 inches in length. This will be found difficult to secure and unduly expensive. Taking the lowest failure found in the tests in the United States, 17,080 lbs. per lineal inch, and using for convenience say 8,500 lbs. per inch for abuse "b" it will call for a little over 15 inches of length. Use "c" is an every-day demand on the knife edge, and the 15-inch will give a load slightly in excess of 5,800 lbs. per lineal inch.

Of course it is not every track scale which is called on to weigh daily the short coupled, heavy capacity gondola coal car, and many scales will not receive such severe service. The long coal cars used in the west and all box cars have a much longer wheel base and are less severe on the weighing machine. Yet when we go back to the first question, and ask "what is the capacity of a track scale?" we see how very far former methods were from giving us an adequate scale.

The figures accompanying need but a brief description. Fig. 1 shows the reaction on the end section of a track scale with the greatest carload possible concentrated thereon. Fig. 2 represents similar reaction on a centre section of a similar scale with like load. Fig. 3 is the reaction on an end section under the load of a modern switch engine and Fig. 6 is a like reaction on a centre section under a Mikado engine with a wheel load of 30,000 lbs. It should be understood that an engine with a supposedly equal load on the drivers, in, practice shows a differing load. Tests on the Pennsylvania have found as much as 44,500 lbs. wheel load on an engine, due to bad alignment and improper distribution. This will not, probably, make any large difference in the load precipitated on any section of the scale, it being balanced by a lesser load on an adjacent wheel.

Fig. 5 gives the bending moment and section modulus for

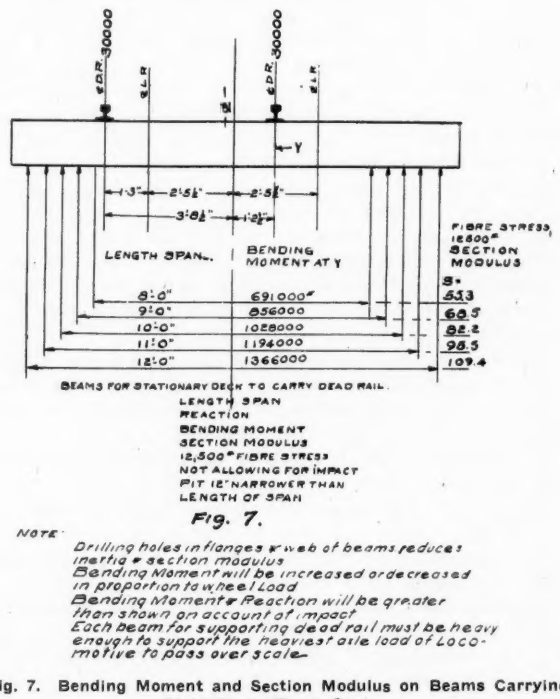


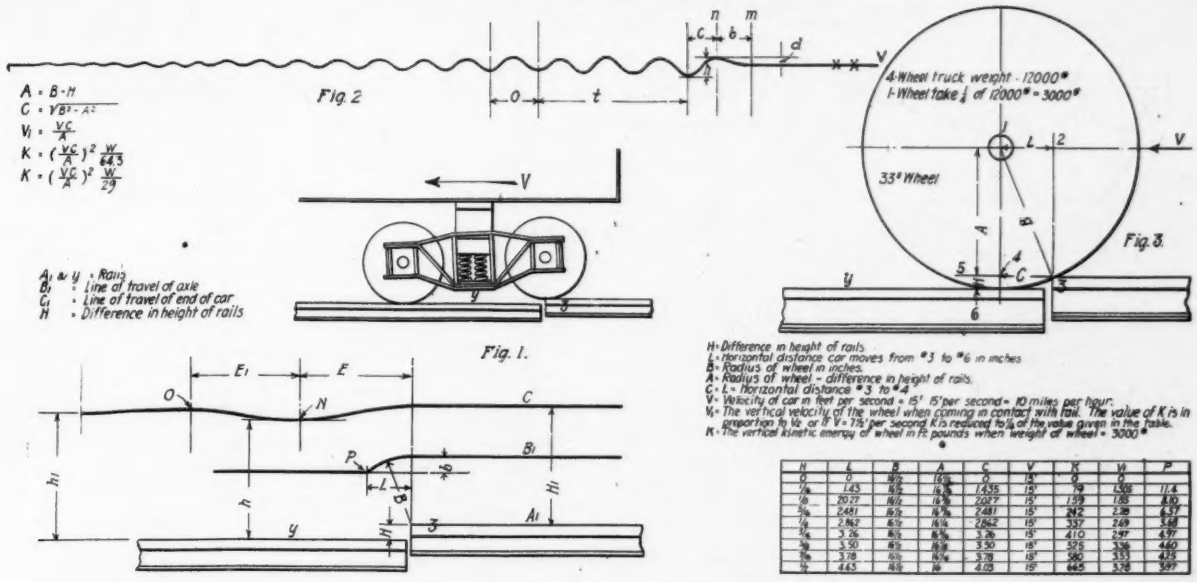
Fig. 7.

NOTE
Drilling holes in flanges & web of beams reduces inertia & section modulus
Bending Moment will be increased or decreased in proportion to wheel Load
Bending Moment & Reaction will be greater than shown on account of impact
Each beam for supporting dead rail must be heavy enough to support the heaviest axle load of Locomotive to pass over scale.

Fig. 7. Bending Moment and Section Modulus on Beams Carrying Rigid Deck Track Scales.

girders of weigh bridge under cars shown and Fig. 4 shows the like for a consolidation engine. Fig. 7 gives same for the beams to carry a rigid deck of track scale supporting dead rail.

Figs. 8, 9 and 10 are from drawings submitted by Mr. H. O. Hem, and No. 8 is a study in the action of car wheels entering the scale. We have, as the first wheel enters, a blow caused by the wheel dropping across the open space and striking a yielding substance. The weigh bridge sinking gradually for an undetermined distance under the impact. As the second pair of wheels of the truck enter the scale they have a greater fall, due to the scale rail having settled under weight of first pair of wheels and approaching more nearly to a rigid body. The blow delivered differs in each case and is subject to several modifying conditions. It is not thought necessary to enter any further into discussion


A = B - H
C = √(B² - A²)
V₁ = VC/A
K = (VC/A)² W/64.3
K = (VC/A)² W/29
A₁ & y = Rails
D₁ = Line of travel of axle
C₁ = Line of travel of end of car
H = Difference in height of rails
Fig. 1.
Fig. 2
4-Wheel truck weight - 12000#
1-Wheel take ¼ of 12000# = 3000#
33" Wheel
Fig. 3.
H = Difference in height of rails
L = Horizontal distance car moves from #3 to #6 in inches
B = Radius of wheel in inches
A = Radius of wheel - difference in height of rails
C = L - Horizontal distance #3 to #4
V = Velocity of car in feet per second = 15' 15 per second = 10 miles per hour.
V₁ = The vertical velocity of the wheel when coming in contact with rail. The value of K is in proportion to V₂ or if V = 7.5' per second K is reduced to ¼ of the value given in the table.
K = The vertical kinetic energy of wheel in ft. pounds when weight of wheel = 3000#

H	L	B	A	C	V	K	W	P
0	0	16½	16½	0	15'	0	0	
1/16	1.45	16½	16 3/16	1.435	15'	79	1308	114
1/8	2077	16½	16 3/8	2.077	15'	159	1185	230
3/16	2.481	16½	16 5/16	2.481	15'	242	2.28	6.27
1/4	2.862	16½	16¼	2.862	15'	337	249	5.68
5/16	3.26	16½	16 5/16	3.26	15'	410	297	4.97
3/8	3.50	16½	16⅜	3.50	15'	525	338	460
7/16	3.78	16½	16 7/16	3.78	15'	590	353	4.25
1/2	4.45	16½	16	4.05	15'	665	378	3.97

Fig. 8. Action of Car Wheels Entering Scale.

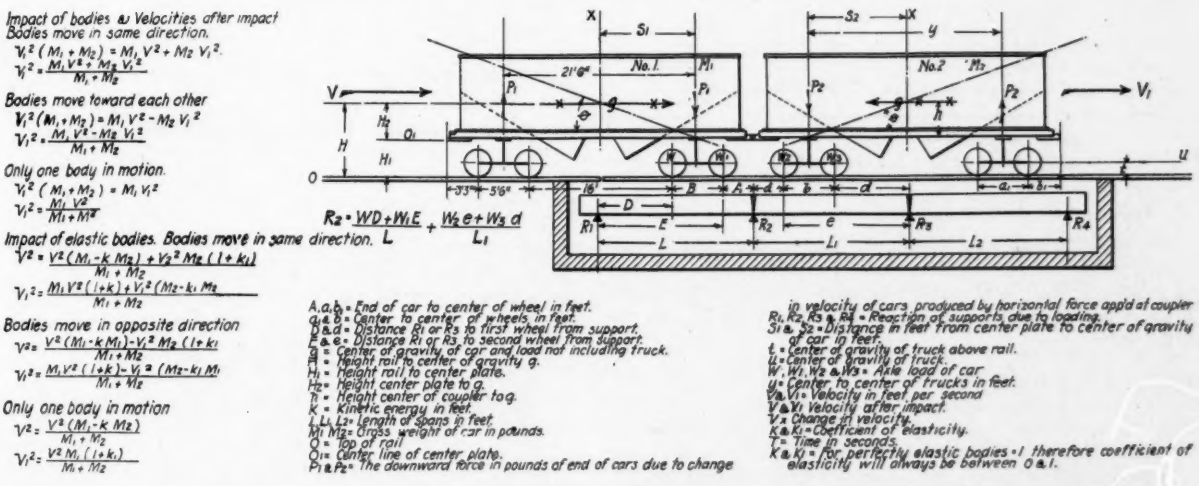

Impact of bodies & Velocities after impact
Bodies move in same direction.
V₁²(M₁ + M₂) = M₁V² + M₂V₁².
V₁² = (M₁V² + M₂V₁²)/(M₁ + M₂)
Bodies move toward each other
V₁²(M₁ + M₂) = M₁V² - M₂V₁²
V₁² = (M₁V² - M₂V₁²)/(M₁ + M₂)
Only one body in motion.
V₁²(M₁ + M₂) = M₁V₁²
V₁² = M₁V²/(M₁ + M₂)
Impact of elastic bodies. Bodies move in same direction.
V² = V²(M₁ - kM₂) + V₂²M₂(1 + k₁)/(M₁ + M₂)
V₁² = M₁V²(1 + k) + V₁²(M₂ - k₁M₂)/(M₁ + M₂)
Bodies move in opposite direction
V₂ = V²(M₁ - kM₁) - V₁²M₂(1 + k₁)/(M₁ + M₂)
V₁² = M₁V²(1 + k) - V₁²(M₂ - k₁M₁)/(M₁ + M₂)
Only one body in motion
V² = V²(M₁ - kM₂)/(M₁ + M₂)
V₁² = V²M₁(1 + k₁)/(M₁ + M₂)
R₂ = WD + W₁E/L + W₂e + W₃d/L₁
A, a, b = End of car to center of wheel in feet.
c & b = Center to center of wheels in feet.
D & d = Distance R₁ or R₃ to first wheel from support.
E & e = Distance R₁ or R₃ to second wheel from support.
G = Center of gravity of car and load not including truck.
H = Height rail to center of gravity g.
H₁ = Height rail to center plate.
H₂ = Height center plate to g.
h = Height center of coupler to g.
K = Kinetic energy in feet.
L, L₁, L₂ = Length of Spans in feet.
M₁ M₂ = Gross weight of car in pounds.
O = Top of rail
O₁ = Center line of center plate.
P₁ & P₂ = The downward force in pounds of end of cars due to change in velocity of cars produced by horizontal force appl'd at coupler
R₁, R₂, R₃ & R₄ = Reaction of supports due to loading.
S₁ & S₂ = Distance in feet from center plate to center of gravity of car in feet.
t = Center of gravity of truck above rail.
u = Center of gravity of truck.
W, W₁, W₂ & W₃ = Axle load of car
y = Center to center of trucks in feet.
V & V₁ = Velocity in feet per second
V & V₁ Velocity after impact.
V x Change in velocity.
K & K₁ = Coefficient of elasticity.
T = Time in seconds.
K & K₁ = For perfectly elastic bodies = 1 therefore coefficient of elasticity will always be between 0 & 1.

Fig. 9. Formulae, When Cars Come Together on Track Scales.

of this, as by reference to the load on end, as compared with centre sections, it will be seen, that as all are made of equal strength the end section is not nearly so heavily loaded as the central ones. Although this problem is interesting it is not at all necessary to be solved.

Fig. 9 gives some formulas regarding the action when cars come together on a scale and is worthy of careful study. This has been already discussed somewhat. Owing to the fact that the two cars are not absolutely rigid bodies and to the fact that they are in contact for so very brief a space of time, it is impossible to determine this force, but that it adds a very great strain to the working parts of a scale is readily apparent. Fig. 10 shows the error arising from dull pivots. This is worthy of study. It will be noted that in addition to changing the multiplication of the lever, it gets the pivots out of line, and will, when lever is not level, introduce an error in proportion to the two ends of lever which will vary as the lever is less or more out of level.

The article in *Engineering* for July last pointed out the advantages possessed by the articulated or hinged girder over the continuous for the weigh bridge of a track scale. Fig. 11 shows the weigh bridge of a four and five section scale. Some tests made with these are published herewith, which will be followed by more complete ones as the data becomes available. A four section scale with weigh bridge 54 feet long, composed of four I beams weighing, each, 80 lbs. per foot. Test load weighing 70,059 lbs. was moved across this scale and observations taken at points as indicated on upper plan in Fig. 11. First column indicates location of test load (1-2 meaning between sections 1 and 2), second the weight shown on bearing of section No. 1 and third column the bearing on section No. 2:

	%	%
L	.7575	.2668
1-2	.3963	.6275
2	.0694	.8560
2-3	—.0477	.5490
3	—.0465	.2080
3-4	—.0363	.0622
R	—.0272	.0165

A five section scale 51 ft. long with weigh bridge composed of two I beams each weighing 100 lbs. per foot. Test weight 60,059 lbs. was moved across scale and observations made, as in first instance, at six points and partially at a seventh. Second column shows the weight on section 1 and third column the weight on section three:

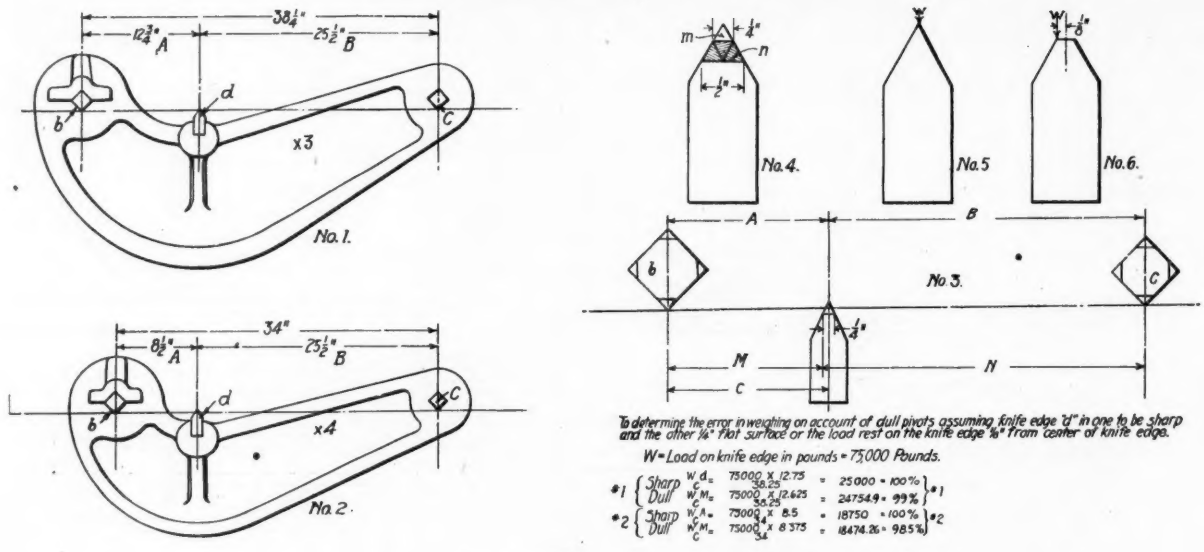

No. 1.
No. 2.
No. 3.
No. 4.
No. 5
No. 6.
To determine the error in weighing on account of dull pivots assuming knife edge "d" in one to be sharp and the other ⅛" flat surface or the load rest on the knife edge ⅛" from center of knife edge.
W = Load on knife edge in pounds = 75,000 Pounds.

Fig. 10. Error Arising from Dull Pivots. Track Scales.

	%	%
L	.4387	.0060
2	.1572	.1359
2-3	—.0035	.4405
3	—.0327	.6520
3-4	—.0277	*
4	—.0177	.1022
R	—.0093	.0059

*Assumed as .4405.

The same type of scale as the last was equipped with a temporary weigh bridge made with wooden stringers and a test load of 20,000 lbs. was passed over it with the following results, column 2 shows load on second section and third column the load on the fifth section:

	%	%
1	.0400	—.0020
1-2	.5430	.0010
2	.9230	—.0111
2-3	.6030	—.0390
3	.1721	—.0460
3-4	—.0060	—.0710
4	—.0220	.0560
4-5	—.0420	.4410
5	—.0340	.8400

Weight is plus where no sign is shown.

This further indicates the greater load which is thrown on scale bearings by a continuous weigh bridge, as well as the possible danger of bearings shifting as the load fluctuates on the minus side.

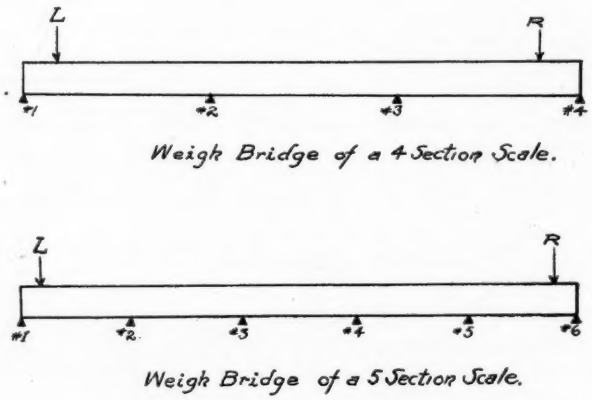


Fig. 11. Weigh Bridges of Four and Five Section Scale.

The East & West Coast, Bradentown, Fla., has about 36 miles of the 53-mile line from Bradentown to Arcadia, Fla., now completed.

The Erie & Ontario, building from Smithville, Ont., to Port Maitland, has track laying finished to Dunnville and is making surveys on a section between Dunnville and Port Maitland.

The construction program of the Erie for 1915 is understood to include the following: Cleveland & Mahoning Valley line, Youngstown to Girard, O., 5 miles; Allegheny to Carrolton, N. Y., 5½ miles; Chicago to Erie, between Lomax and Griffith, Ind., 36 miles; Sharon Railway, between Ferrona and West Middlesex, Pa., and between Newcastle water works and Newcastle Junction, Pa., 12 miles; Nypano Railroad, between Steamburg and Waterloo, N. Y., 9 miles.

Edwin W. Gearhart and J. A. Helm, Scranton, Pa., who recently purchased coal and timber lands in Clay county, Ky., contemplate the construction of a railway from East Bernstadt to Manchester, Ky.

Work will start in the spring on the proposed railroad between Roseburg, Ore., and Coos Bay. Roseburg voted $500,000 in bonds last fall, which probably will be sufficient for 15 miles.

The projected 30-mile extension of the Wisconsin & Northern from Crandon to Shawano, Wis., will be constructed this year.

THE PRATT & WHITNEY CO., Hartford, Conn., tool and machinery manufacturer, has bought the plant of the Pope Mfg. Co. for $300,000. The plant is being put in shape for manufacturing operations and B. W. Hanson, works manager of the Pratt & Whitney Co., is superintending the installation of the machinery. Most of the buildings purchased are to be occupied immediately by Pratt & Whitney workmen, except such space as will be required for the storage of the old equipment in the plant until this is sold by the receiver, Col. Pope.

The Signal Department

Interesting Installation of Block Signals on a Single Track Trunk Line.

CHICAGO, BURLINGTON & QUINCY RAILROAD.

A block signal installation of unusual interest has recently been completed on the McCook Division of the C. B. & Q. The installation covers 112 miles of single track between Denver and Akron on the main line from Chicago to Denver.

The Absolute Permissive Block System of signaling is used throughout except on nine miles between Derby and Denver, Union Station. This system provides an absolute block between passing sidings for opposing train movements but permits any number of following movements similar to double track operation. In fact when the direction of traffic is once established train movements can be made with the same despatch as on lines where traffic is always in the same direction. Between Derby and Denver Union Station, being within the limits of Denver yard, the absolute permissive system would not be applicable. Therefore, absolute single track block signaling was used. Separate home and distant signals are used, the latter being approximately 2,500 feet in rear of the former. This arrangement, however, is modified at the entrance to passing sidings where the distant signal for the home signals for movements leaving the siding is placed on the same mast with the entering signal, the passing sidings are in all cases 4,000 ft. long.

The signals for movements leaving the sidings are usually located about 100 feet outside of the switch points and opposite the entering signals. In some cases this distance is increased to permit switching movements without blocking opposing trains at the next passing siding.

A somewhat novel arrangement is adopted for closing in train movements at two places on ascending grades. When ascending, an additional intermediate signal is used to shorten the blocks known as a permissive signal, and in order to avoid stopping heavy trains on the grade, a special rule applies to these signals permitting trains to proceed when the blade is in the horizontal position or a yellow light displayed at night without stopping, prepared to stop short of any obstruction. In the opposite direction with these signals omitted the blocks are unusually long, thus increasing the train spacing where the speed is higher.

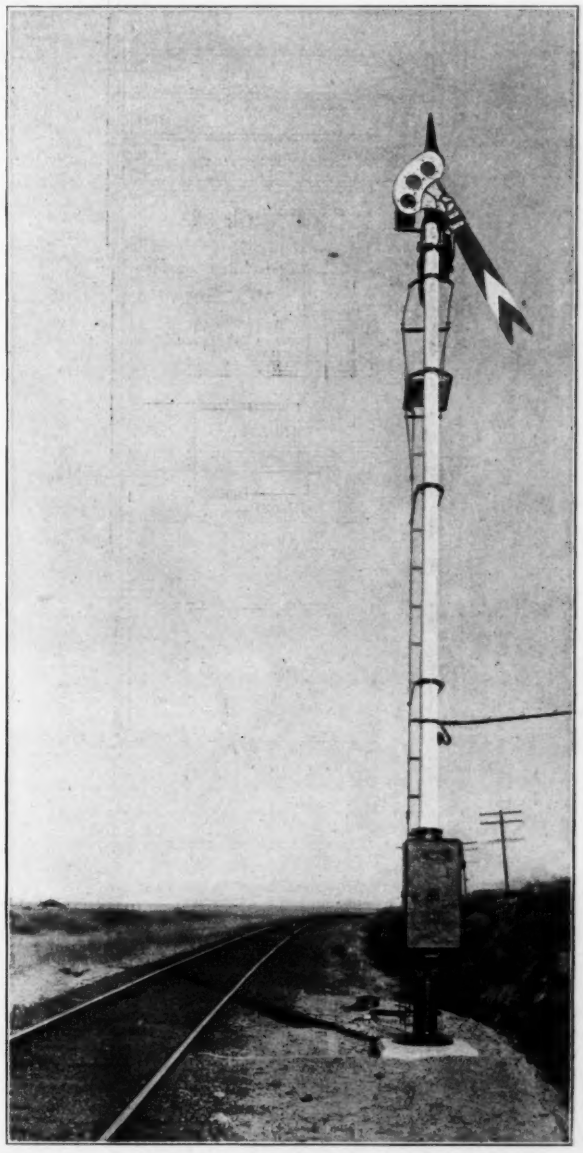
The various signals are distinctive for both day and night indications. The day indications are distinguished by the different types of blades. Absolute home signals have square end blades enameled red with white stripe. Permissive signals used on ascending grades have square end blades enameled yellow with black stripe, and the distant signals have forked end blades enameled green with white stripe.

The night indications are distinguished by the use of white for clear and red for stop for absolute home signals. White for clear and green for caution for distant signals. Night indication for permissive signals are white for clear, yellow for caution with a purple marker light seven feet diagonally below the semaphore light.

The signals are of the two position type operating from 0 degrees to 60 degrees, lower quadrant. R.S.A. poles and fittings are used excepting the railway company's standard three-light spectacle which is used with enameled sheet steel blades.

Federal type "4" signal mechanisms, Fig. 7, are used, applied at the top of mast. This mechanism is universal and can be readily adapted for upper quadrant operation, if indications in the upper quadrant should subsequently be desired.

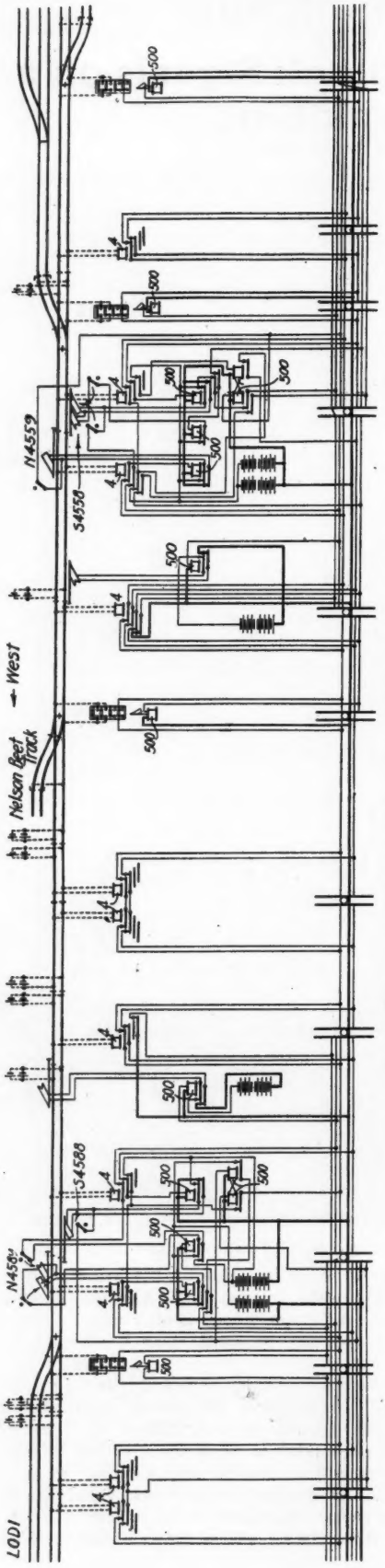
The circuit arrangement for controlling these signals was developed by the Signal Department of the C. B. & Q. It consists primarily in the use of a special interlocking relay for establishing direction in combination with the usual home and distant control circuits. When one side of this relay is deenergized to establish a direction for traffic, this direction cannot be changed until the track between sidings is clear again. However, following movements may be made under signal protection in the ordinary way.



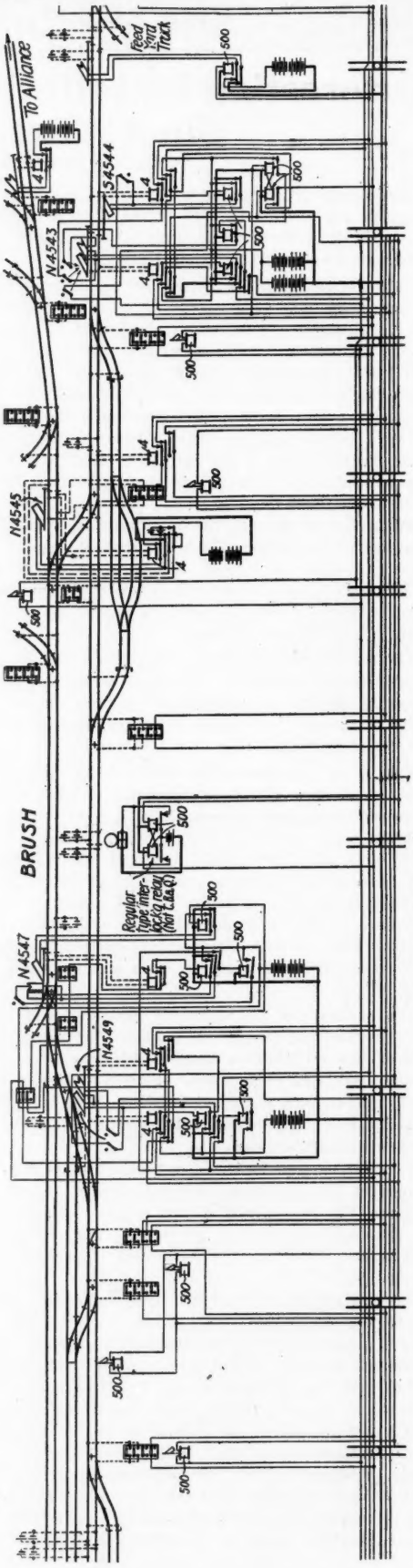
Distant Signal. Single Track Automatic Block Signals. C. B. & Q.

Fig. 1 shows a typical layout and circuits for a portion of this installation between Story and Brush. The latter is a junction point for the connection to Billings, Mont., and a "calling-on" arm is provided on block signal on the Billings line west of the station governing movements to all routes except the main line. An intermediate permissive signal No. S 4524 for closing in on ascending grade is shown east of Brush.

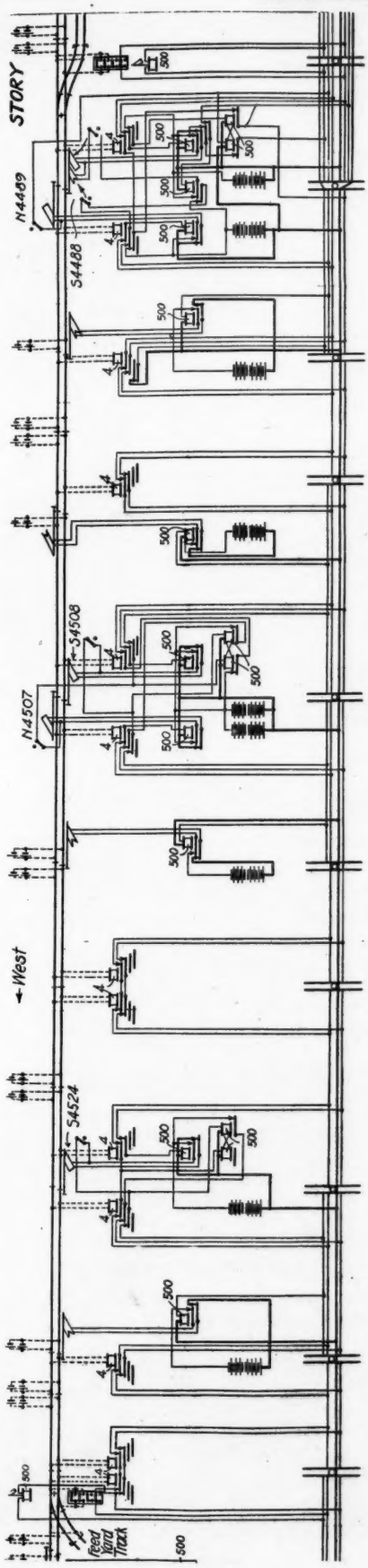
Fig. 2 shows the signals set for an eastbound train approach-



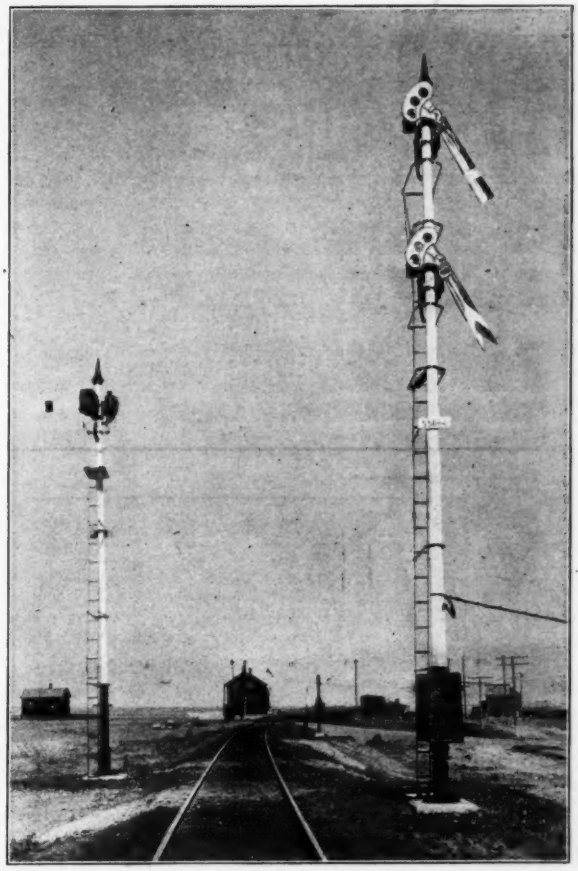
Plan of Circuits. Single Track Automatic Block Signals. C. B. & Q.



Plan of Circuits. Single Track Automatic Block Signals. C. B. & Q.

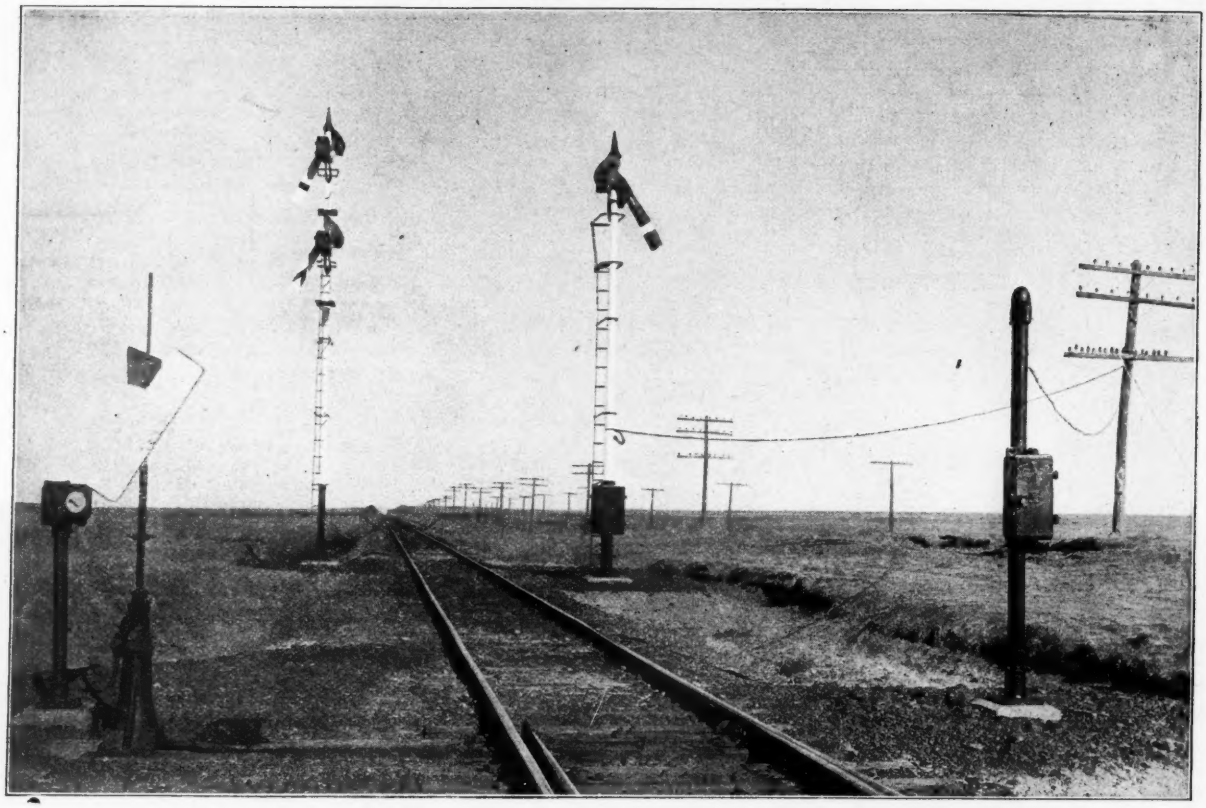


Plan of Circuits. Single Track Automatic Block Signals. C. B. & Q.

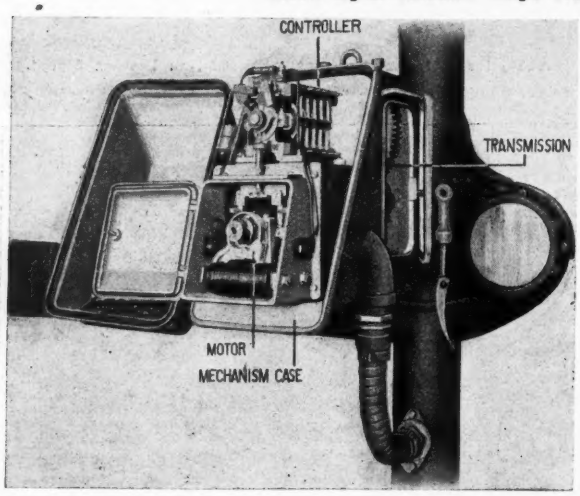


Double Home Signal Location, with Call-on Distant Signal. C. B. & Q.

Double Home Signal Location. C. B. & Q.

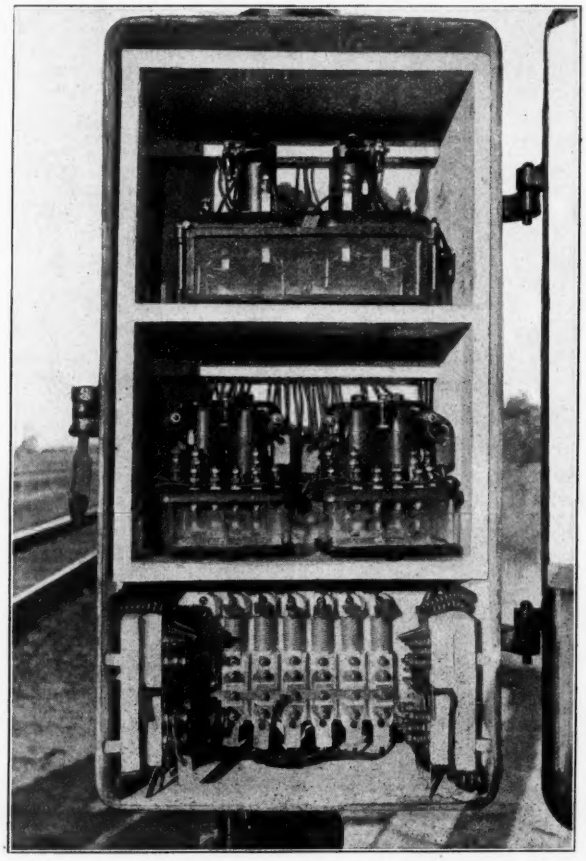


Double Signal Location. Single Track Automatic Block Signals. C. B. & Q.

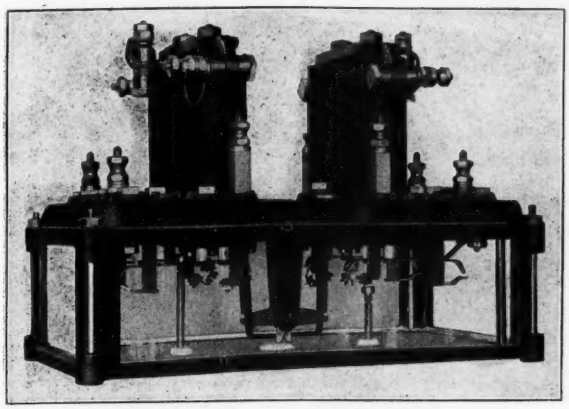


Top Post Mechanism. Single Track Automatic Block Signals. C. B. & Q.

ing the west end of passing track at Keenesburg, being protected against opposing movements by the single arm starting signal. The engineman is receiving, from the two-arm signal, the indications that there are no westbound trains between this signal and the next passing track in advance, nor is there any eastbound train between this signal and the second signal in advance. Should there have been a westbound movement, out of the next passing track in advance, a caution indication would be displayed by the lower or distant arm. If this westbound movement had reached the first track section in advance of the starting home signal at the east end of the passing track, the top or home arm would be in the stop position, and a caution indication would have been received at the distant signal in the rear, Fig. 3.



Relay Case with R. S. A. Lighting Arresters and Terminal Board. C. B. & Q.



Interlocking Relay. Single Track Automatic Block Signals. C. B. & Q.

A typical end of passing track layout is shown in Fig. 4. The single arm signal being the absolute signal governing movements from the passing track. The two-arm signal governs movements on the main line through the length of the passing track. The switch indicator warns any employee wishing to use the switch of the approach of a train. The location of the switch circuit controller through which home signal control relay circuits are carried is shown, together with the cable post, lightning arrester and terminal box, and method of making up and suspending line drops.

Iron, wood-lined relay boxes are used as illustrated in Fig. 5. These are placed either on the signal mast or on 4" cable posts and on the same side of the track as the pole line. The interlocking relay, Fig. 6, is located on the upper shelf and the type "F" track relays on the next shelf with a lower compartment for lightning arresters and R.S.A. terminals.

Flexible connections are used between the terminals and relays and a very thorough system of wire tagging is used which not only designates the function which the wire controls but also the point of attachment. In this way, a circuit can be traced or relay replaced without referring to the circuit plan.

The wires from the trunking are run through the foundation in a cast iron duct imbedded in concrete. The trunking enters directly into an extension of this duct, thus eliminating all possibility of wires becoming exposed due to shrinking of the trunking.

B. S. C. O. primary battery in R. S. A. barrel-shaped heat-resisting glass jars, housed in concrete battery wells are used for line and motor circuits. Track circuits average 2,300 ft. in length and are fed by two cells of gravity battery housed in cast iron battery chutes. The ballast, which is a smelter slag, makes an ideal ballast for track circuit operation.

The work on this installation was begun in April and completed in December and was designed and installed under the direction of Mr. J. B. Latimer, Signal Engineer of the C. B. & Q., by the Federal Signal Co.

THE LAW ADJUSTABLE RESISTANCE UNIT.

The Central Electric Company of Chicago has issued a pamphlet discribing the law Adjustable Resistance Unit, for which they are distributing agents, the device being manufactured by the Railroad Signal Supply Company of St. Paul, Minn.

Adjusting a resistance to such small variations as are required by a track circuit can only be accomplished by resistanceless contacts. The LAW ADJUSTABLE RESISTANCE UNIT meets this requirement in a most ingenious way. The contact seat and resistance wire being absolutely solid and forming a part of the base itself, there is no possibility of variation. The self-cleaning feature always insures a bright, clean contact.

The principle of the spring contact as used in this unit is identically the same as that used in the design of all standard signal apparatus.

BASE.

This is of heavy porcelain, grooved to receive the resistance wire. It is provided with three points of contact so that it can be permanently screwed to very uneven surfaces.

RESISTANCE WIRE.

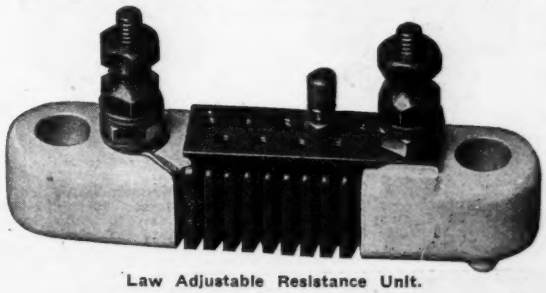
Consists of heavy German silver, thoroughly protected from moisture.

INSULATION.

The wire is wound in grooves in the porcelain base and then treated with heavy coatings of moisture-proof, chemical-proof, insulating compound.

ADJUSTMENTS.

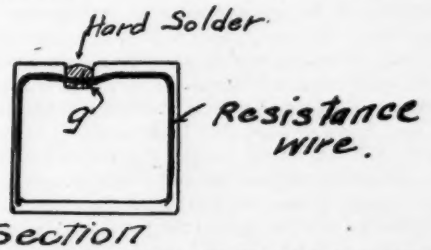
The total resistance of the unit is one ohm (can be wound to any resistance desired) so divided as to give ten adjustments from 0 to one ohm in tenth ohm steps.



Law Adjustable Resistance Unit.

CONTACTS.

THE ADJUSTMENTS ARE ACCOMPLISHED BY CHANGING THE POSITION OF A SCREW PLUG. THIS DRIVES AGAINST A SOFT METAL SEAT,



Cross Section. Law Adjustable Resistance Unit.

THOROUGHLY CLEANING THIS SEAT AND MAKING ABSOLUTE CONTACT. A SPRING PLATE HOLDS THE SCREW PLUG IN POSITION.

CLOSED CIRCUIT.

The resistance wire is connected with both terminals of the unit. Changing the position of the contact does not open the circuit and hence does not cause extra signal movements.

TERMINALS R. S. A.

The resistance wire is connected to binding posts by means of APPROVED eyelet terminals soldered to wire.

SIGNAL LIGHTING TRANSFORMERS.

A new line of miniature air-cooled transformers, known as type M, has been developed by the General Electric Company for railway signal lighting. These transformers are distinctive in application and design. They are enclosed in a neat and compact case, either for indoor use or in a weatherproof form for outdoor use.

The transformers are fitted with standard R. S. A. terminals, as shown by the accompanying illustrations, and are furnished in sizes for 25 to 125 watts, 25 and 60 cycles.

A lamp of from 2½ to 5 watts is generally considered sufficient for signal illumination; consequently, a transformer of this kind with 6 to 12 volt, 2½ to 5 watt, high efficiency Mazda lamps makes a very satisfactory, as well as economical, system of lighting.

Type M Outdoor Signal Lighting. Transformer, 50 to 125 Watts, 60 Cycles; 110 Volts Primary, 10 Volts Secondary.

Type M Indoor Signal Lighting Transformer, 50 to 125 Watts, 60 Cycles; 110 Volts Primary, 6-12 Volts Secondary.

Personals

P. E. Crowley, general manager of the New York Central & Hudson River R. R., has been appointed assistant to vice-president of the New York Central R. R., and will have general charge of transportation of the consolidated lines between New York and Chicago. Under the reorganization plan, two grand divisions of the merged lines will be established. The eastern division will be under the supervision of William J. Fripp, general manager, with headquarters at Albany, N. Y. D. C. Moon will be general manager of the western division, with headquarters at Cleveland, Ohio. The entire railroad will be divided into four operating districts, the first comprising all lines between New York and Syracuse, the second all lines between Syracuse and Buffalo, the third all lines between Buffalo and Toledo, and the fourth all lines between Toledo and Chicago, with a special terminal district at New York, embracing the electrical division. Albert S. Ingalls, hitherto general superintendent of the Lake Shore & Michigan Southern Ry., will have charge of the line between Buffalo and Toledo, with headquarters at Cleveland, Ohio, and Frank H. Wilson, assistant general superintendent at Cleveland, will be general superintendent in charge of the line between Toledo and Chicago, with headquarters in Chicago. T. W. Evans, general superintendent, will have charge of the line between Buffalo and Syracuse, and from Montreal to Clearfield, Pa., with headquarters at Syracuse, N. Y.; E. J. Wright is made general superintendent in charge of the line into the Adirondacks and the Harlem division, and Miles Bronson is appointed general superintendent, in charge of the electrical division.

The following changes in personnel have been announced by the Illinois Central railroad: Lewis W. Baldwin, appointed general superintendent of the lines south of the Ohio river, vice John F. Porterfield, promoted to general superintendent of transportation, with offices in Chicago; Lawrence A. Downs, appointed superintendent of the Kentucky division, with office at Louisville; William Atwill, appointed superintendent of the Minnesota division with office at Dubuque, Iowa.

W. H. Fogg, superintendent of the Northern division of the Monon, at LaFayette, Ind., has had his jurisdiction extended over the Southern division, succeeding J. M. Baths, resigned.

W. B. Hodge has been appointed assistant engineer maintenance of way of the Big Four with headquarters at Wabash, Ind.

Lewis W. Baldwin.

J. M. Baths, division superintendent of the Monon at LaFayette, Ind., has been appointed assistant division superintendent of the Chicago Great Western, with headquarters at Red Wing, Minn., in place of W. B. Harrison, resigned.

Carl Bucholtz has been appointed division superintendent of the Meadville division of the Erie Railroad.

Harry Bortin has resigned as assistant to general secretary of the Presidents' Conference Committee on Valuation, to engage in private practice, specializing in valuation work. He was formerly engineer in charge of the valuation department of the Union Pacific R. R.

J. R. W. Ambron has been appointed chief engineer of the Toronto Terminals Railway, of the Grand Trunk, with headquarters at Toronto, Can.

L. A. Downs.

V. C. Nally has been appointed roadmaster of the Galveston, Harrisburg & San Antonio, with headquarters at San Antonio, Tex., vice P. Sweeney.

W. A. Scott has been appointed roadmaster of the Galveston, Harrisburg & San Antonio with headquarters at Victoria, Tex., vice H. J. Gordon.

J. W. Bent has been appointed supervisor of track of the Big Four with headquarters at Springfield, Ohio, vice John Tarbutton.

W. T. Stafford has been appointed supervisor of track of the Erie with headquarters at Hammond, Ind., vice G. C. Metzger.

With The Manufacturers

Fred N. Baylies has been appointed eastern manager of the P. & M. Co., with offices at 30 Church street, New York, effective January 1, 1915. Mr. Baylies was formerly assistant sales manager of the Aluminum Co. of America, with offices in Chicago, but has been a director of the P. & M. Co. since its incorporation.

RECORD FOR HOISTING ENGINES.

Probably the greatest record of hoisting engine production made by any one concern is that of the Lidgerwood Manufacturing Company, New York, who have built more than 37,000 steam and electric hoists during the forty-odd years that they have been in business.

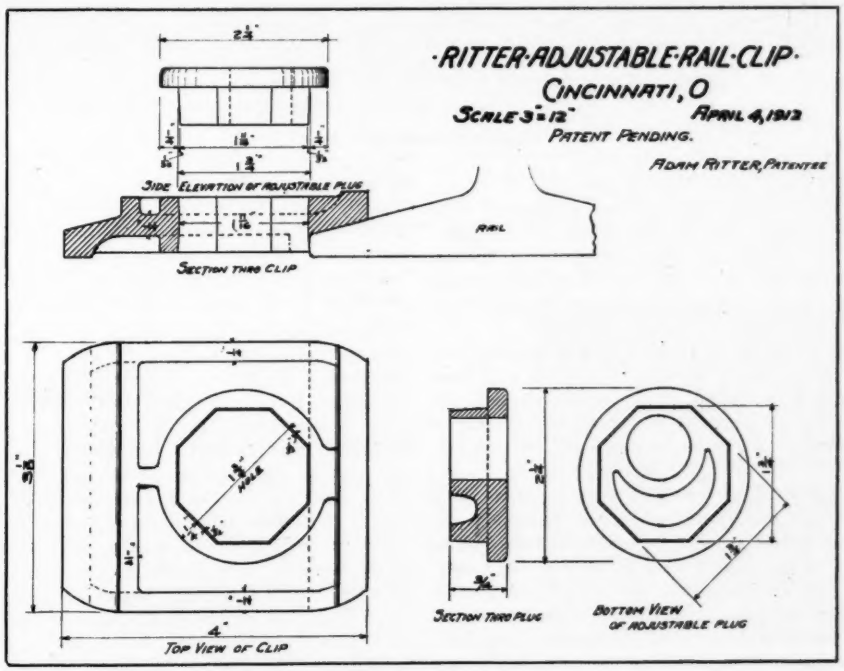
A comparison of the various types of machines built by this company today with those of thirty years ago, and still in use, is very interesting from an engineering standpoint and shows the marked advance in the way of time and labor saving improvements that has been made in hoisting machinery practice.

THE RITTER ADJUSTABLE RAIL CLIP.

A. Ritter, architect, C. N. O. & T. P. Ry., Cincinnati, has designed and is having manufactured by the Ritter Adjustable Rail Clip Co., Cincinnati, O., a new rail clip which is a device for adjusting and fastening rail to concrete walls of engine pits, cinder pits, turntable rail, or any place where anchor bolts are necessary for holding rails in place.

The clip is made reversible in order to give the greatest possible adjustment, has an eccentric sleeve plug, which can be inserted on either side of the clip, placed over anchor bolt and rotated on same to adjust the clip to the required distance between the rail and the anchor bolt—the variation of adjustment being ⅛ inch to 1¾ inches.

The clip is now being installed on the engine pits for new 20 stall engine house of the C. N. O. & T. P. Ry. Co., at Ludlow, Ky., and also for new paint shop at Chattanooga, Tenn.



Ritter Adjustable Rail Clip.

MODERN GALVANIZING PLANT

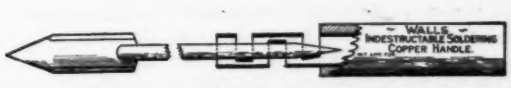
The new galvanizing plant recently completed by the A. M. Byers Company at its mills in Pittsburgh contains the most modern and efficient equipment for manipulating the galvanizing process known today. The plant and its installation were designed especially for the Byers process.

This process by which wrought iron pipe is galvanized is particularly thorough and of high standard. The galvanizing specifications call for hot metal process, a coating of highest grade prime western spelter, and a deposit of 100% heavier than that required in government galvanizing specifications.

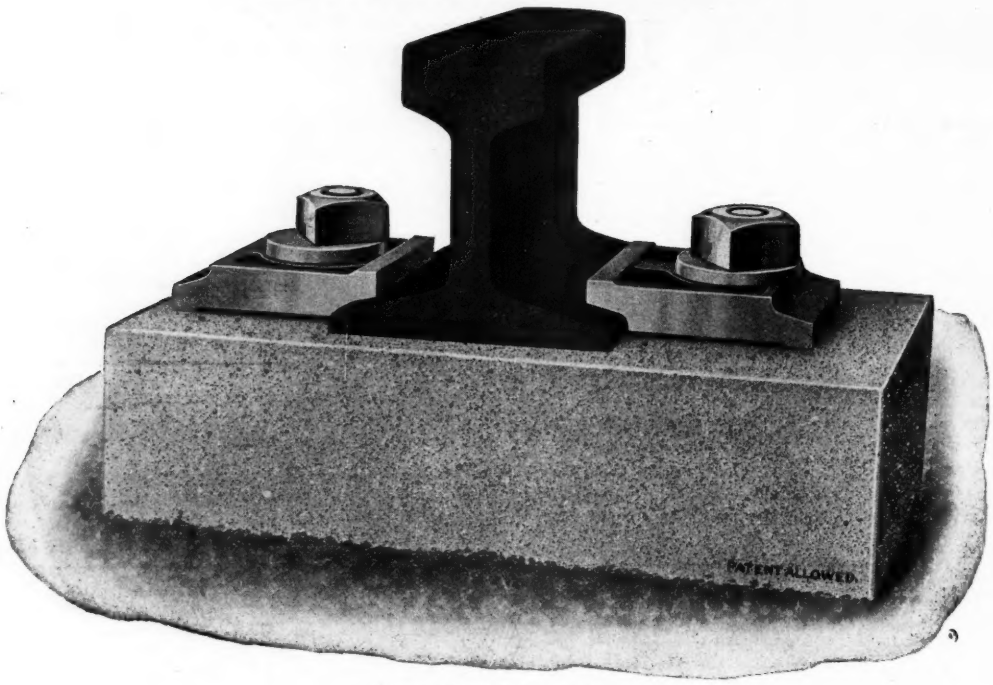
The careful weighing and inspection before galvanizing, the device for turning the pipe in the baths; the extra long cleansing period; the pyrometer regulated kettles; the superior quality and absolute purity of the spelter, and the final weighing that assures the proper coating—each of these steps are specialized and handled by experts.

WALL'S INDESTRUCTIBLE SOLDERING COPPER HANDLE.

T. P. Walls Tool & Supply Co., New York, have produced an indestructible soldering copper handle. This handle is made of .065 pressed steel and is always cool no matter how hot the soldering copper. The groove locks the shank of the copper, and handle and copper become as though they were cast together. The handle will outlast 25 common wooden handles.



Wall's Soldering Copper Handle.



Ritter Adjustable Rail Clip.

A MODERN 150 TON SCALE.

The Standard Scale & Supply Company, of Pittsburgh, Pa., who are manufacturing high grade scales for use by railroads, manufacturers and the trade, have contributed the following article on "The Modern 150 Ton Scale," which will show purchasers of scales some of the important details not thought of in the past.

Inquiries for railroad track scales of 150 ton capacity are now the rule, yet it is not known to many purchasers what this demand involves when steel gondola cars can contain only 50 tons of coal. The investigations by the Interstate Commerce Commission hastened the introduction at large of this capacity of scale.

Complaints of shippers, carriers and consignees that weights were inaccurate induced the investigation, which resulted in location of causes of complaint, and suggested remedies. Mistakes in bills of ladings and overcharges were not the only causes of dissatisfaction. The equipment on many roads was found utterly deficient. Some railroads based claims of correct weights upon superior equipment. The following quotations illustrated: "It would not only insure correct weight for itself, but by its massive design and substantial construction would impress its customers with the undoubted accuracy in case of disputed weight." This is a forceful argument against assumption that anything bearing the name of scale and its maker is sufficient proof of correct weight.

There are other benefits resulting from installation of modern scales. The cheapness of the maintenance of high grade installation and modern design, long life, no breakdowns, no delays in traffic and accurate weights eliminating disputes and loss, all combine to rapidly pay the difference to original cost.

Railroad companies are adopting proven facts and installing the modern type of scale and the number of manufacturers, shippers and other users of scales who are following the same wise course is increasing.

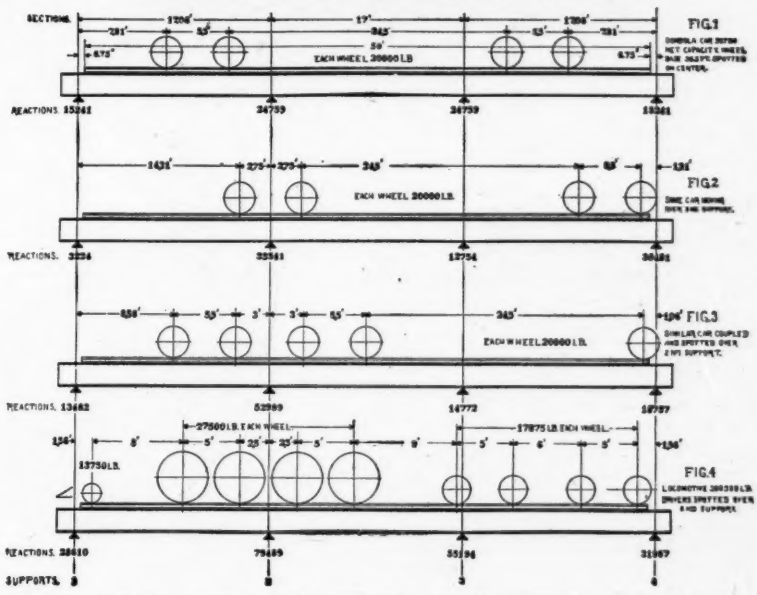
Such a scale is shown in the accompanying illustrations taken during erection of a 150 ton capacity 50 ft. platform railroad track scale at the entrance of a prominent manufacturing plant, from the surface and inside of pit. The approaching track meets the platform, each weight rail is supported over one pair of 20" beams, as clearly shown, and both pair of beams are suspended by means of vertical hangers upon a massive lever system. Directly under the center of each weight rail is the bearing of platform in special design, which produces that mysterious sway horizontally as well as vertically when weighing a cargo. The lever system is supported on twelve piers, four on each side of pit, about 17 ft. apart, and four in center line of scale.

Inexperienced examiners cannot conceive the necessity of such massive construction nor the nominal capacity of 150 tons, when the present freight cars are stenciled "Capacity 100,000 lbs." To remove doubts and wrong ideas, it must be understood that a scale in the roadbed should be as strong as a bridge. Being connected with the continental system it can receive cars from any country and must meet the pressure from short and long freight cars as well as locomotives when the necessity arises. Many scales have failed when a locomotive passed over, others broke by coupled cars in regular train order. Repeated breakdowns, however, teach the efficiency engineers that it is bad policy to adhere to ill design and unproven assumptions.

Analyzing the service of a modern 150 ton scale, the diagram in Figure 4 shows quickly the increase of pressure and permits a deduction of method of nominal capacity, debarring locomotives.

In Fig. 1 the supports are about 17 ft. apart, as established by some railroad systems, length of weight rail 50 ft. exactly. The end of rails, therefore, are vertically above, and 6¾" inside, of supports 1 and 4, permitting the load to drop proportionately between end and middle supports. This overlay of support is nearly 1/30th of span, some designers propose to increase it to 1/5th of span, which in such a scale would relieve the end and overcharge the middle supports as will be seen by comparing Figures 1 and 2. A gondola car 100,000 lbs. capacity, wheel base 35½ ft., truck centers 30 ft., and axles 5½ ft. apart, may carry loaded 20,000 lbs. on each of the 8 wheels. When spotted in center of platforms, reactions are produced on supports 1 and 2 same as in 3 and 4. The outer receiving as much less as the inner increase over 20,000 lb. wheel load. Evidently reactions 1 and 4 will be still smaller should the supports 1 and 4 be moved to 20 ft. distance instead of 17.06 feet, setting up still greater uneven reaction and wears in levers and supports.

Fig. 2 represents the same car moving over 2d support and approaching roadbed beyond platform at the other end, rapidly



Figures 1, 2, 3 and 4. Loads of Different Type Cars and Locomotive on Track Scale.

alters the reactions decreasing at one end, attaining an increasing gradually at 4th support to double the amount of that in Fig. 1. The apparent relief in supports 1 and 4 fig. 1 vanishes as car begins to move and proves thereby the correct division of sections and relative length of rail to supports for gondola cars of given dimensions. Short cars do not materially alter the results, as the 3d reactions in Fig. 2 is too far in recess to compare with reaction 2.

Fig. 3 shows two of above gondolas coupled and passing over scale in train order, as it often happens, setting up in 2d support a reaction of 52,989 lbs., which is the live load and 16 times greater than 3,224 lbs. (R1. Fig. 2) in common every day service. As the train proceeds the 3d support will be subject to same pressure as the 2d, but 1st and 4th reaction cannot now be much greater than R4 Fig. 2, 30,481 lbs. From these reactions a designing capacity may be established for a 50 ton operating capacity car as follows:

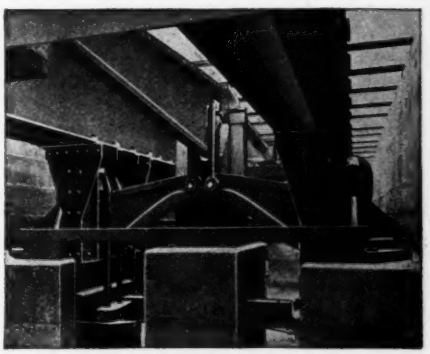
4 Supports	@	53,000 lb.	212,000
4 Supports	@	30,500 lb.	122,000
		Total lb.	334,000

The commercial 150 ton is, therefore, right to weigh gondolas of 50 ton capacity, when its mechanism shall not be excessively strained. In designing a 150 ton scale, approximately 53,000 lbs. of live load is found to be the weight upon each main lever exclusive of dead load of 3,000 lbs., making a total of 448,000 for 8 supports for the purpose of weighing 50 ton freight cars, spotted, in motion or in train order.

In many factories and yards locomotives must ordinarily pass over and to show the effect of 48 ft. wheel base engine weighing 390,500 lbs., having 27,500 lbs. upon each of 8 drivers, 17,875 on each of 8 trailers and 13,750 lbs. on one pony wheel, spotted on same scale, see next figure.

Fig. 4. A locomotive causes greatest reaction in 2d support of 79,489 lbs., with dead load not less than 82,000 lbs., making a total of 656,000 for whole scale. Many engines weigh less than this illustration, but when more than 80 tons should be debarred from passing a scale not designed for it, because the downbreak is invited by over weight and the allowance in strength is much exceeded.

Building laws allow 16,000 lbs. per sq. inch structural steel in buildings, for live load in bridges, 8,000 to 12,000 lbs. Two gondolas in motion, as in Fig. 3, may set up 80,000 lbs. pressure over a span of 17 ft., causing a bending moment of 204,000 lbs. and fiber stresses of nearly 8,700 lbs. per sq. inch in two 20" beams 65 lbs. per ft. and when the 290,500 lb. engine passes 9,600 lbs. per sq. inch is the generated stress which is within building laws. These are immense quantities of which scale buyers have no conception, when request is made for 150 ton railroad track scale. The picture price and bill of old 100 ton scales comes to mind of the purchaser and it takes a lot of arguments to show how the investigations of the Interstate Commerce Commission have cleared up all the fragments and methods. The price of a modern 150 ton scale does not increase in the same ratio as

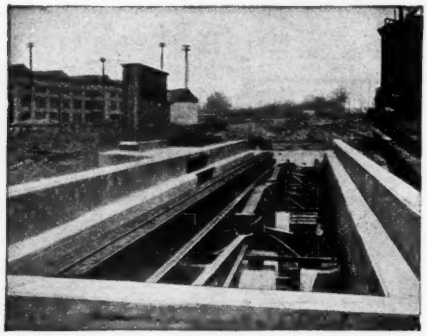


Foundations in Pit of 150-Ton Scale, Showing Weigh Beams and Lever Arms.

the old 100 ton actually increased from 50 ton, which was made a standard 30 years ago, because the present method ascertaining the reactions on supports were not applied in the past.

Now, however, the aspects have changed, the purchaser gravely considers the cost of above installation and the probable benefit from weighing his material and products. The diagrams with four figures show that specifying the capacity as 150 ton alone does not signify the quality and not only opens a wide interpretation, but also permits a variety of design based upon different understandings.

Railway engineers have set up a definition to protect their companies as follows: The 150 ton scale will be so designed that one-half of this amount of 150,000 lbs. placed as a static load on each of the four sections will produce knife edge stresses not exceeding 5,000 lbs. per lineal inch deflections in the lever from a straight line joining the end pivots not exceeding at any point 1/2000 of their length figured as a single beam; and unit stresses not exceeding:



Pit of 150-Ton Scale.

For Cast Iron in Tension.....2,000 lb.
For Cast Iron in Compression.....3,000 lb.
For Cast Steel in Tension.....7,500 lb.
For Cast Steel in Compression.....8,000 lb.

The product of this specification is a scale that should have the same strength and character, no matter where made. The purchaser would receive full value for his price and be in position to check his purchase by having an engineer measure up the levers and parts and make final calculation from the goods delivered. This specification assuming the 2 main levers to one section, each loaded with 75,000 lbs., eliminates foggy interpretations for impact and deadloads, fixes the length of pivots in same as 75000/5000-15" long, and by the calculable deflections the amount of strength is verified. A purchaser may pay a small fee to an expert or architect if he is unable to check the goods in the same manner as he pays a lawyer, physician or accountant for services for the satisfaction of receiving what he pays for is well worth the outlay.

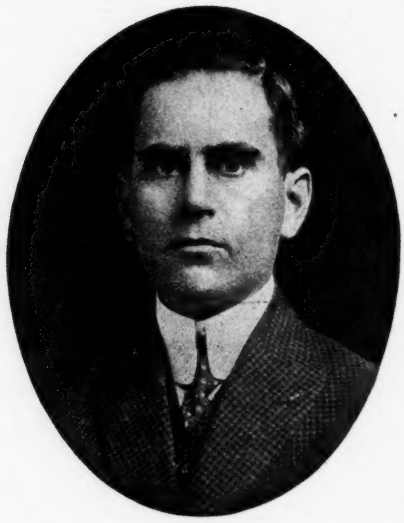
Referring to diagram Fig. 3, it shows the greatest load 52,989 upon one support. When engines are debarred, it would, therefore, be a waste of material to adhere to above railroad specification where no locomotive passes over a scale. It has been customary to rate a scale without a margin and assume the amount of capacity distributed uniformly over entire scale. 100 ton capacity divided into 8 supports requires 25,000 lbs. on each. Fig. 2 shows that support 2 may be subjected to 33,541 lbs., teaches that to buy scale without any definition in regard to capacity and loading is deceiving, and proves that a gross load of 80 ton may hurt a 100 ton scale because it is overtaxed 20% when the rated capacity is yet far in excess. A broken scale is not expected to weigh, yet the damage done by overstrained scales has never been computed; both shipper and consignee suspected something wrong somewhere. Congress has had under consideration since May 29, 1914, a bill to be known as the Weight and Measures Act. States and cities appoint officers to inspect scales and weights. Railroad companies buy only such scales as are approved by their own engineers, and other users of scales will profit by their experience and be guided by enlightened judgment.

E. A. Everett was appointed signal engineer of the Gordon Primary Battery Co. on January 1, with headquarters at 50 Church Street, New York. O. S. Flath continues in charge of the Chicago office of this company.

T. A. WILLSON & Co., Reading, Pa., were awarded the grand prize at the second international exposition of safety and sanitation at Grand Central Palace, New York, on December 12 to 19, 1914. This award was on the merits of the Willson safety glass, the Willson goggle and the Albex eye protector.

W. H. ARKENBURGH, formerly with the publicity department of the Union Switch & Signal Co., has become associated with the sales department of the National Carbon Co.

THE NATIONAL BRASS Co., Houston, Tex., has been incorporated with the following officers: President G. F. Cotter; vice-president, J. W. Cain, and secretary, F. H. Littrell. The company will specialize in the manufacture of car and locomotive bearings, as well as general railway castings.



E. A. Everett, Signal Engineer, Gordon Primary Battery Co.

THE UNIVERSAL SAFETY BRAKE Co. has been incorporated with $25,000 capital stock by R. and L. M. Bernfeld, S. Wiesenberg, 341 Crimmins avenue, New York.

THE REMY ELECTRIC Co., Anderson, Ind., has purchased a plot of land in Detroit, upon which it will erect a plant. It will employ 1,500 men when operations are running full. The reason for the move is to bring the works nearer the company's center of trade. The concern is capitalized at $1,500,000, and has an annual payroll of $1,750,000. It manufactures magnetos, engines and electrical devices.

The Kansas City, Mexico & Orient is said to be purchasing material preparatory to improving its line in Kansas, Oklahoma and Texas.

The Kansas City, Kaw Valley & Western has prepared plans for its extension from Bonner Springs, Kan., to Linwood, 10 miles, and from Linwood, Kan., to Lawrence, 10 miles.

The Public Service Commission for First District of New York has approved plans and specifications of New York Municipal Ry., New York, for construction of stations on the Sea Beach R. R.

The Monroe & Texas, with capital stock of $40,000, has been chartered in Louisiana to construct a railroad, to begin at Monroe, La., and run westerly to a point on the Sabine river.

The Northern Pacific has completed the North Yakima & Valley between Spitzenburg and Weikel.

Surveys are being made by the Northwestern Pacific, it is reported, for the construction of a branch line from Healdsburg to Christine, Cal., about 61 miles.

The Oregon-Washington R. R. & Navigation Co. has opened for service the new Point Defiance line, which is a portion of its Puget Sound route between Portland, Tacoma and Seattle. This line completes the double track between Portland, Ore., and Tacoma, Wash.

The Ozark Valley, which was recently chartered in Missouri, is a reorganization of the Williamsville, Greenville & St. Louis.

The Rolla, Ozark & Southern, incorporated in Missouri early last year, has most of the right of way secured and about nine miles of grading is finished between Rolla and Anutt, Mo.

The Southern, in connection with its proposed expansion of yards at North Birmingham, Ala., plans the removal of its Avondale shops to the Finley yards. The concentration of all terminal work at the Finley yards is expected to facilitate shipments. It is rumored that later the terminal facilities and shops of the Alabama Great Southern, controlled by the Southern, also may be moved to the Finley yards.

W. J. Newman Co., 19 N. Curtis St., Chicago, Ill., have been awarded contract for electric railway from Hamilton to Connersville. Work covers about 20 miles of line.